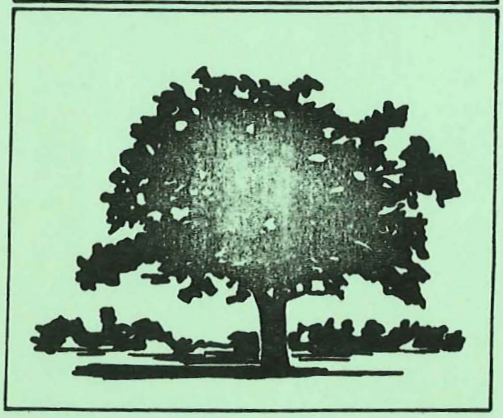


FOREST PEST CONDITIONS IN WISCONSIN

ANNUAL REPORT 1985

DEPARTMENT OF NATURAL RESOURCES
BOX 7921
MADISON, WISCONSIN 53707

FOREST PEST CONDITIONS IN WISCONSIN ANNUAL REPORT - 1985

Compiled and Edited by Allen J. Prey, David J. Hall, and Jane E. Cummings

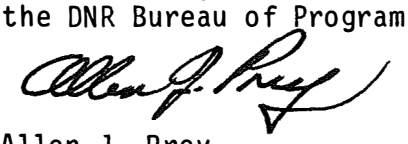
DEPARTMENT OF NATURAL RESOURCES
Division of Resource Management
Bureau of Forestry

ACKNOWLEDGEMENTS

This record of the activities of forest pests and other destructive agents of growing trees in Wisconsin's forest nurseries, plantations, and natural timber areas was made possible by the dedicated work of pest management personnel in each district and at the Forest Pest Management Laboratory in Madison. DNR foresters, other Department field personnel, cooperators in other public agencies and private forest industry contributed valuable assistance in monitoring the forest lands in all classes of forest ownership.

There were some personnel changes and additions to the forest pest management program in Wisconsin in 1985. William H. Kearby was hired on September 1, 1986 as Forest Entomologist for the North Central District and stationed at Rhinelander, WI to replace Stanley E. Banash who retired in December 1984. Also James F. Storandt was hired in November 1985 as Forest Pathologist/Assistant Nursery Superintendent stationed at Griffith State Forest Nursery, Wisconsin Rapids, WI.

Preparation of this Annual Report was a result of a team effort involving William Kearby, Frank Morse and Shane Weber, DNR District Entomologists who submitted district reports. Jane Cummings and Dave Hall, Beth Schuh, Forest Pest Unit, Madison, consolidated the District reports and wrote the final draft. Mike Drilias, Limited Term Employee, Forest Pest Unit, prepared the computer generated and hand drawn maps and Chris Trevorrow of the Southern District Program Services did the word processing. Final printing was done by the DNR Bureau of Program Services.



Allen J. Prey
Supervisor, Forest Pest Management
May 15, 1986

TABLE OF CONTENTS

Forest Pest Control Personnel.....iii

Introduction.....1

Forest Pest Conditions by Tree Species.....3

ASPEN.....3
Aspen Bronzing . . . Leaf Rust . . . Forest Tent Caterpillar

BALSAM FIR/SPRUCE.....4
Spruce Budworm . . . Balsam Gall Midge . . . Balsam Twig Aphid . . .
Yellowheaded Spruce Sawfly

BASSWOOD.....4
Basswood Thrips . . . Linden Looper

BIRCH.....6
Birch Leafminer . . . Birch Skeletonizer . . . Yellow Birch Dieback

Butternut.....8
Butternut Canker

CHERRY.....8
Cherry Scallop Shell Moth

HEMLOCK.....8
Hemlock Mortality

LARCH.....9
Larch Needlecast

MAPLE.....10
Greenstriped Mapleworm . . . Bruce Spanworm . . . Sapstreak

OAK 11
Actinopelte Leaf Spot . . . Oak Wilt . . . Oak Webworm . . .
Oak Skeletonizer . . . Fall Cankerworm . . . Walkingstick . . .
Post Oak Locust . . . Orange Striped Oakworm . . . A Leaf Gall Maker

PINE.....15
Diplodia Canker and Shoot Blight . . Scleroderris Canker . . .
Red Pine Shoot Blight . . .Red Pine Decline and Pocket
Mortality . . . Jack Pine Budworm . . . Pine Tussock Moth . . .
European Pine Sawfly . . . A Pine Sawfly . . .
Redheaded Pine Sawfly . . . Introduced Pine Sawfly . . .
Red Pine Shoot Moth . . .Eastern Pine Shoot Borer . . .
Pine Grosbeak . . . Saratoga Spittlebug . . . Pine Spittlebug . . .
Pine Bark Adelgid . . . Pine Root Collar Weevil . . .
Pales Weevil . . . White Pine Weevil . . . Northern Pine Weevil . . .
Pine Bark Beetles . . . Red Turpentine Beetle . . . A Bark Beetle . . .
White Grubs . . . Plains Pocket Gopher . . . White Pine
Needlecast . . .White Pine Needle Blight

BLACK WALNUT.....26
Plantation Black Walnut Canker

MISCELLANEOUS SPECIES.....28
Gypsy Moth . . . Fall Webworm . . . A Bagworm . . . Air Pollution

CHRISTMAS TREES 29
Cyclaneusma Needlecast

NURSERY PROBLEMS.....32
White Pine Root Rot

APPENDIX A.....34
Redheaded Pine Sawfly Phermone Study

APPENDIX B.....40
Stem Canker on Black Walnut

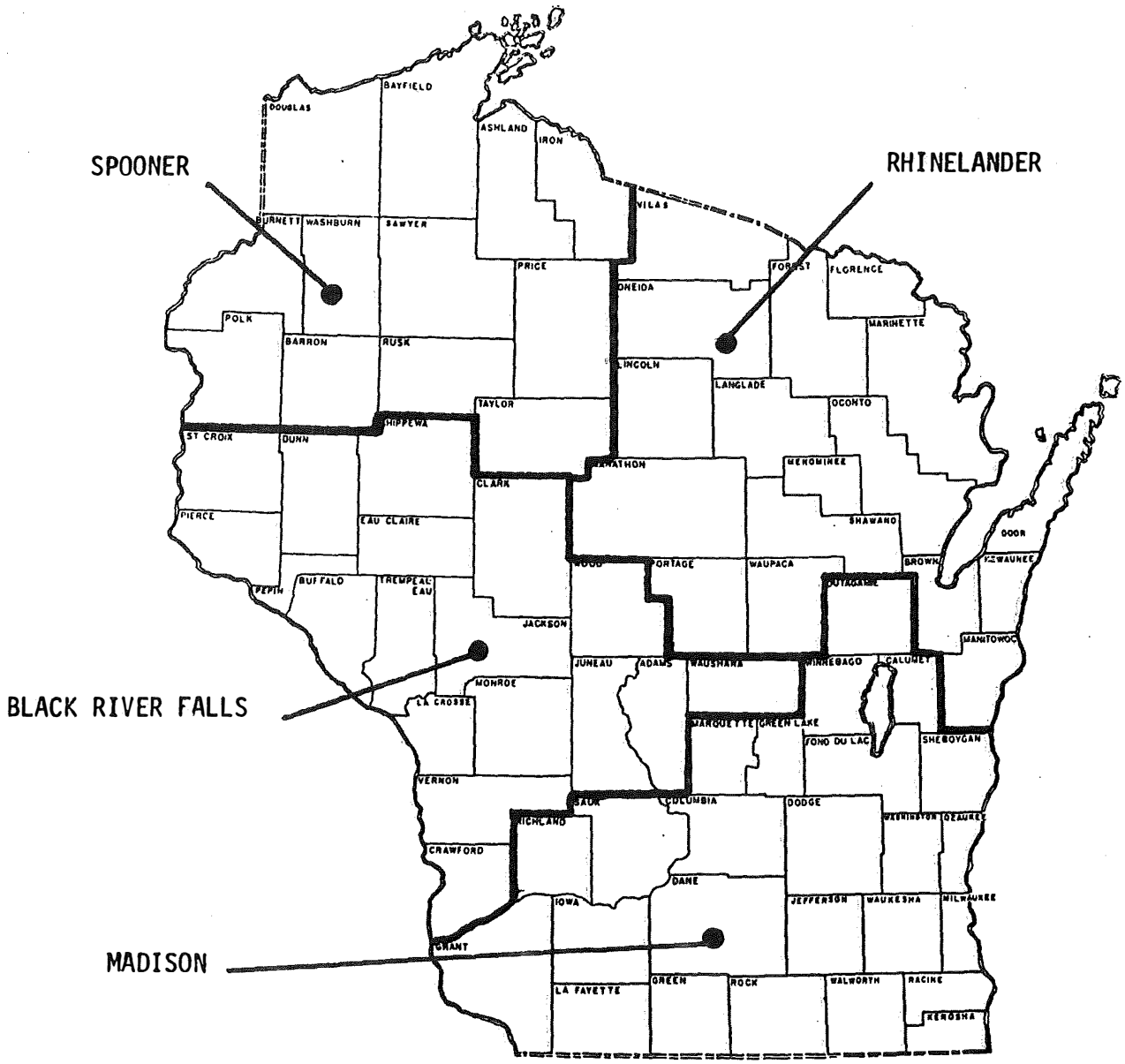


Figure 1. Station locations of Wisconsin Department of Natural Resources District Entomologists and Forest Pest Unit Personnel.

Department of Natural Resources
Forest Pest Management Personnel December 31, 1985

Name	Title	Address	Telephone
Prey, Allen J.	Supervisor, Forest Pest Management	DNR, 3911 Fish Hatchery Road, Madison, WI 53711	608-266-2834
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Cummings, Jane E.	Forest Pathologist	DNR, 3911 Fish Hatchery Road, Madison, WI 53711	608-266-3428
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o o o

Introduction

This report lists the major insect and disease problems reported on forest land in Wisconsin in 1985. While this report does not list all the insect and disease problems that occurred on forest land, it does highlight major or noteworthy insect infestations, and disease occurrences including abiotic damage to trees.

In addition to surveying over 10 million acres of forest land for pests in 1985, DNR District Entomologists and Forest Pest Staff were responsible for teaching integrated pest management principles to DNR foresters, industrial foresters and private woodland owners. A Red Pine Pest Management Training session was held at Tomahawk, WI, in June and an Oak Pest Management session held at Perrot State Park near Trempealeau, WI in October.

A forest pest exhibit displaying forest pest leaflets and free pest diagnostic services were available at the Wisconsin Christmas Tree Producers Annual Summer Meeting at Stevens Point in July. A similar display on forest herbicides was presented at the Wisconsin State Society of American Foresters meeting held at La Crosse in November. Also, an Oak Pest Management Exhibit was displayed at a "Challenges in Oak Management and Utilization" symposium held in Madison, WI in March. Similar forest pest exhibits specifically designed to provide technical assistance to woodland owners and general public were displayed at Farm Progress Days held near Winneconne, WI in July, and the Wisconsin State Fair at West Allis, WI in August. Approximately 100,000 people viewed these exhibits.

Teaching the safe use of pesticides and assisting the University of Wisconsin Extension with pesticide applicator training was also a responsibility of the entire Forest Pest Management Staff. Each District Entomologist is also the District Pesticide Coordinator, in charge of numerous DNR activities such as pesticide use, reporting, permits and certifications. Computerized "Herbicide Comparison and Effectiveness Charts" developed in 1984 were updated in 1985, and distributed to Wisconsin foresters. A "Diagnosis chart for common pests of oak in Wisconsin" was computer generated and printed for use at training sessions.

The DNR Forest Pathologist lead an interagency Nursery Disease Control Swat Team in reducing losses in Lake States nurseries from disease such as Diplodia shoot blight, gall rust of pine, and white pine root rot and hosted a meeting of forest scientists and nursery superintendents at Wilson State Forest Nursery at Boscobel in June.

A paper titled "Stem Canker on Black Walnut Caused by Fusarium sporotrichioides" by J. E. Cummings and J. K. Kuntz was presented at the annual meeting of the American Phytopathological Society at Reno, NV in August.

The DNR Forest Pest Staff was called upon to investigate Air Pollution injury to vegetation in Milton Junction, Park Falls and West Milwaukee, WI. Forest Pest Staff also participated in a symposium on "Effects of Air Pollutants on Forest Ecosystems" held at St. Paul, MN in May.

A volunteer program continued at the Forest Pest Laboratory. Volunteers have assisted in aerial surveys and in laboratory work such as labeling slides and filing insect records.

Also a draft of a "site examination check off sheet" for a "Pest Hazard Rating System for site conversion was prepared.

Drafts of computer generated tables of "Forest Management Insecticides" and "Select Tree Removal Herbicides for Forest Management" were developed.

Forest pathology and forest management information was presented at U.S. Forest Service crop tree marking sessions held at Shawano and Tomahawk in October for State, County, Industrial and Consulting Foresters.

A meeting was held with forest pest officials in Upper Michigan to develop strategies for an oak wilt control program in northeastern Wisconsin and upper Michigan. Then the status of the oak wilt situation in northeastern Wisconsin and control strategies were presented to Lake Michigan District Forestry Personnel at a District meeting in Green Bay.

The Forest Pest Staff investigated three separate reports of red pine pocket mortality in Jefferson, Walworth and Waukesha counties. A conceptual model of the situation was developed. Color infrared aerial photographs were taken of a red pine pocket mortality near Spring Green. Also, a "Red Pine pocket mortality" pest alert was published distributed throughout northeastern United States.

Lectures and laboratory sessions in Forest Entomology and Forest Pathology were presented at the University of Wisconsin - Steven's Point. Also seminar on the status of Forest Management in Wisconsin was presented at the Department of Plant Pathology, University of Wisconsin - Madison.

The testing of a systemic insecticide continued in the red pine seed orchard at Avoca. Three different rates of two formulations were tested. Results will be published at a later date.

ASPEN

Aspen Bronzing - Unknown

No new locations of aspen bronzing were observed in 1985. Known locations of this disease are illustrated in Figure 2. Aspen bronzing has been observed on large-toothed aspen and quaking aspen. On large-toothed aspen, bronzing of leaves in the lower crown occurs during July and August, followed by necrosis in September and death of branches with bronzed leaves in subsequent years. On quaking aspen, chlorotic and necrotic leaf spots are scattered throughout the crown in June and July and bronzing develops in late July and August.

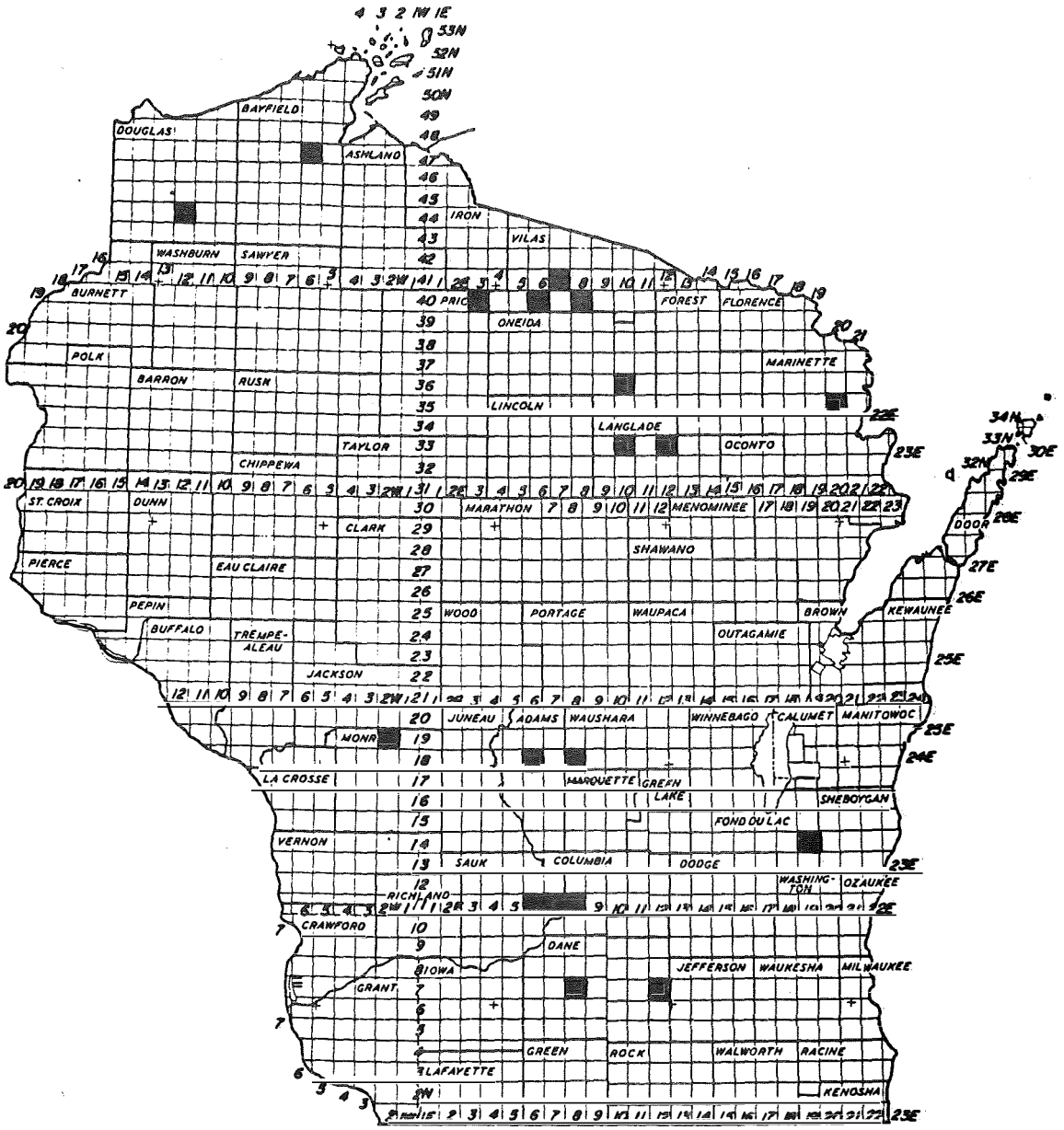

Figure 2. Township locations of Aspen Bronzing in Wisconsin - 1985.

Aspen Leaf Rust - Melampsora medusae Thum.

Incidence of aspen leaf rust was high throughout northwestern Wisconsin. It caused yellowing and early leaf fall on scattered clones.

Forest Tent Caterpillar - Malacosoma disstria (Hubner)

The 1984 outbreak in northern Wisconsin collapsed; no defoliation was reported.

BALSAM FIR - SPRUCE

Spruce Budworm - Choristoneura fumiferana (Clemens)

An outbreak in Ashland County (T45N, R45W; T44N, R3W; T44N, R4W; T43N, R3W) continued with about 15,000 acres of severe defoliation. About 25% of the balsam fir is dead or dying.

A 5000 acre outbreak in Price County collapsed. A light infestation was observed in Sawyer and Washburn counties but egg mass counts indicate a declining population.

Balsam Gall Midge - Paradiplosis tumifex (Gagne)

Reports of infestations in Christmas trees were received from Langlade and Waupaca counties. Infestations in Sawyer and Washburn counties declined noticeably from last year.

Balsam Twig Aphid - Mindarus abietinus (Koch)

A Report of an infestation in Christmas trees was received from Langlade County.

Yellowheaded Spruce Sawfly - Pikonema alaskensis (Rohwer)

Widespread severe defoliation of ornamental and windbreak white spruce occurred in Douglas, Bayfield, Washburn, Burnett and Sawyer counties.

BASSWOOD

Basswood Thrips - Sericothrips tiliae (Hood)

Basswood defoliation occurred in many new locations in the western half of Wisconsin. Pockets of light to moderate defoliation occurred in Washburn, Sawyer, Rusk, Eau Claire, Trempealeau, Richland and Grant counties. The large infestation in northeastern Wisconsin increased in intensity and in size (Figure 3).

The infestation in the Blue and Meteor Hills in Western Rusk and Sawyer counties collapsed but pockets of light to moderate defoliation occurred in several new areas nearby (T35N, R7W; T39N, R9W; T37N, R10W).

Linden Looper - Erannis tiliaria

About 4000 acres of basswood in Iron County suffered moderate to heavy defoliation. Another 2000 acres were lightly defoliated (Figure 4). Male moths were very numerous in the fall.

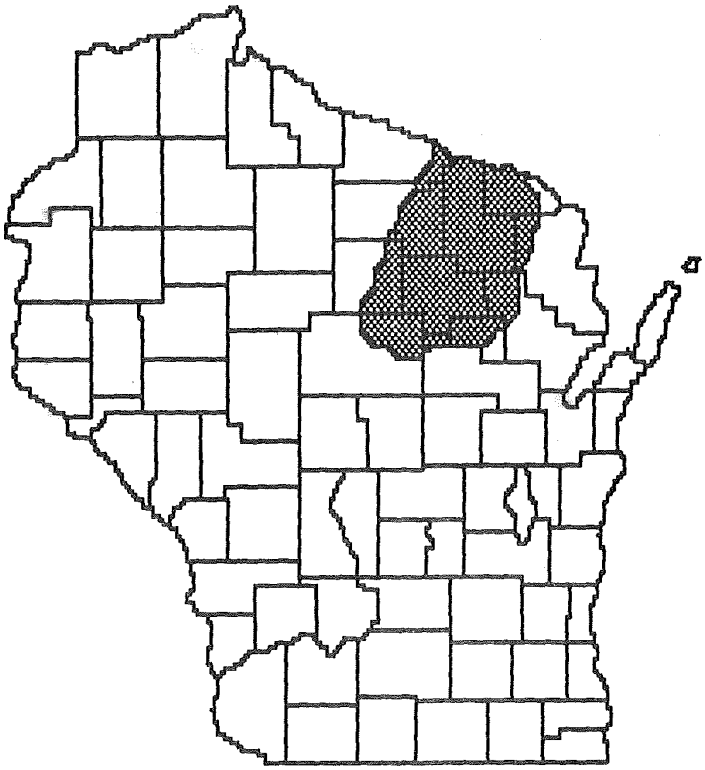

Figure 3. Area in northeastern Wisconsin infested by Basswood Thrips - 1985.

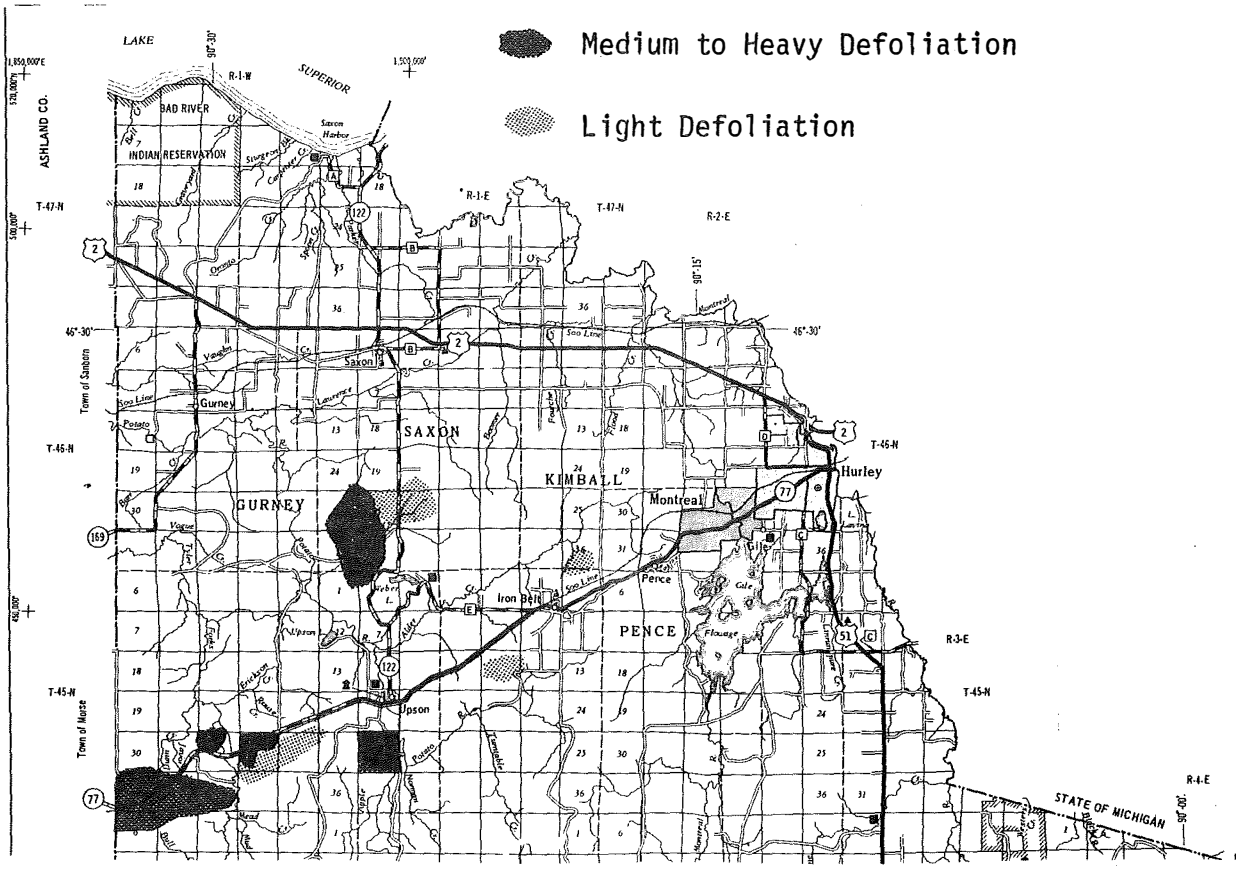

Figure 4. Area of Medium to Heavy and Light Defoliation by the Linden Looper - 1985.

BIRCH

Birch Leafminer - Fenusa pusilla (Lepeletier)

The amount of defoliation of forest and ornamental birch in the northwestern counties was greatly reduced from 1984 levels.

Birch Skeletonizer - Bucculatrix canadensisella (Chambers)

A 5,000 acre infestation in Douglas County collapsed this year.

Yellow Birch Dieback - Unknown

Top dying of yellow birch in northern Wisconsin in 1984 was associated with heavy production of staminate catkins and strobiles, frost, and some defoliation by a leaf chafing snout beetle. Symptoms on pole and sawlog yellow birch included twig and branch dieback, along with leaf wilting and defoliation in the upper crown. In 1985, dieback continued in Florence and Forest counties and on the Menominee Indian Reservation in northeastern Wisconsin (Figure 5). Observations made from an aerial survey on July 16, 1985, revealed scattered dieback in Florence County throughout 30,000 acres in Florence, Fence, and Fern townships. Trees in Florence County that were closely examined in September, 1985 had developed healthy shoots and buds during the summer. In 1986, color infrared photographs will be taken of dieback areas chosen for permanent plots in Florence County and trees in these photo plots will be closely examined. New areas of yellow birch dieback in 1985, are on the Flambeau River State Forest, on the adjacent Chequemegon National Forest, and in northwestern Rusk County. On the Flambeau River State Forest, approximately 15,000 acres in Sawyer County near Oxbow and 4,500 acres in Price County along State Highway 70, had scattered dieback. Approximately 6,000 acres are affected in northwestern Rusk County on the county forest where yellow birch is mixed with basswood, white ash, poplar, and red oak. Presalvage cutting is planned for areas severely affected on the Flambeau River State Forest and in Florence County.

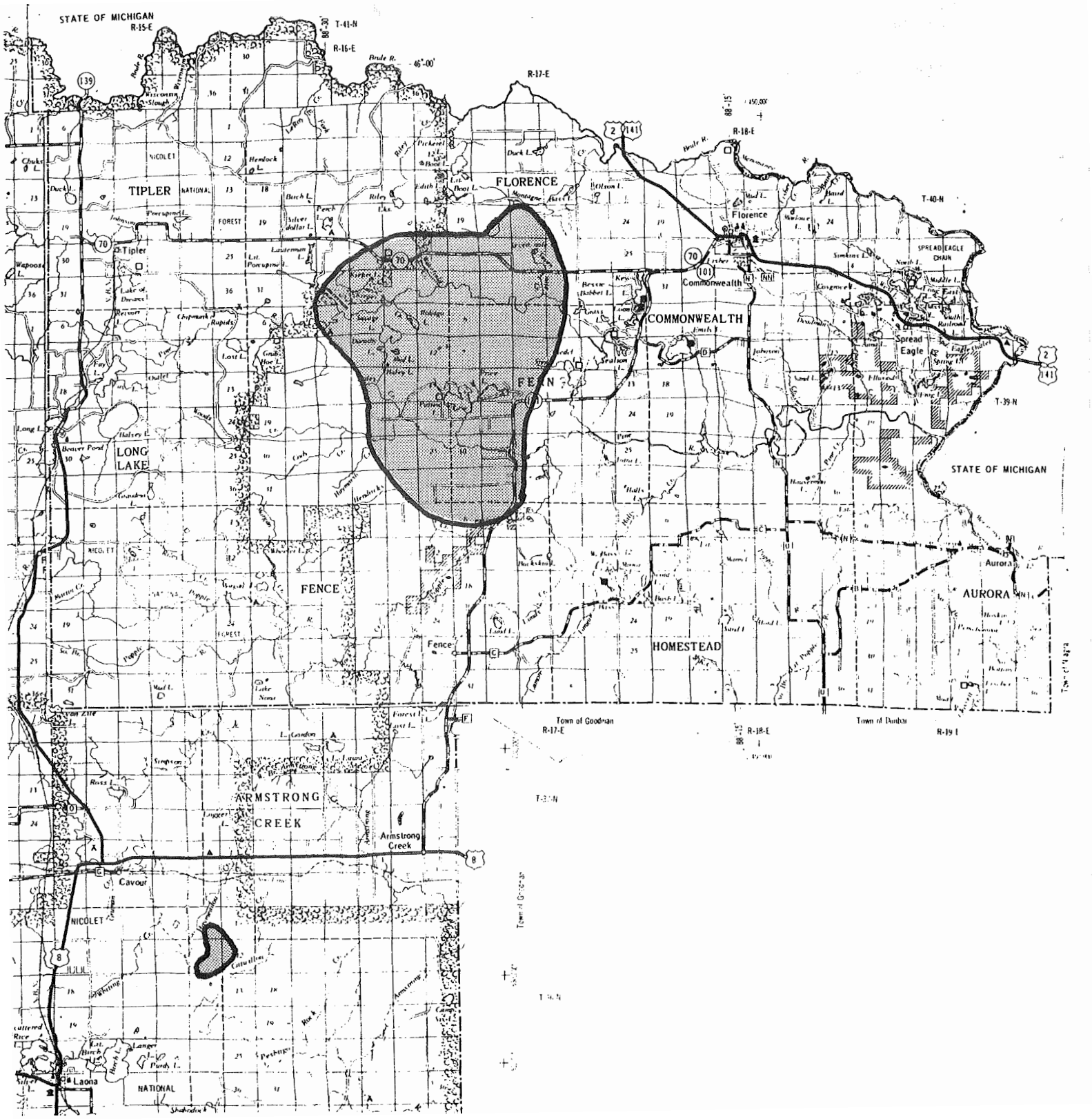

Figure 5. Some Areas of Yellow Birch Dieback in Wisconsin - 1985.

BUTTERNUT

Butternut canker - Siroccoccus clavigignenti-juglandacearum. One new location of this disease was observed on one butternut tree in Lincoln County, T34N, R7E, Sec. 25. Butternut trees on the Menominee Indian Reservation were observed with dieback symptoms but no cankers were found.

Butternut canker continued to kill butternut in the 21 counties where it has been previously reported (Figure 6). Trees of all ages and on all types of sites are affected.

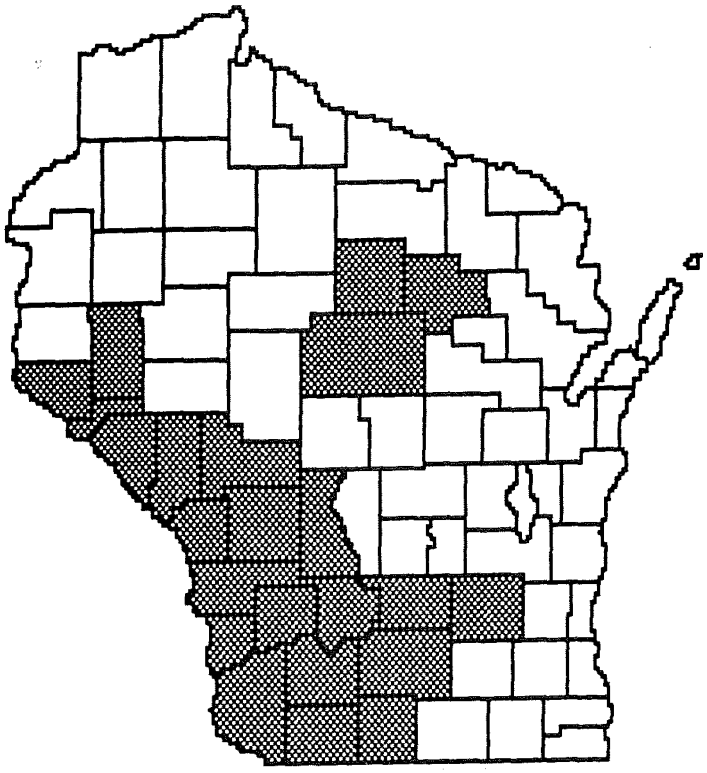

Figure 6. Known county locations of Butternut Canker in Wisconsin - 1985.

CHERRY

Cherry Scallop Shell Moth - Hydria prunivorata (Ferguson)

The 1984 outbreak in Columbia County disappeared entirely this year. No other infestations were reported.

HEMLOCK

Hemlock Mortality

In 1984, mortality and sparce crowns were scattered throughout the hemlock stands on Chambers Island off the northwest end of Door County. Defoliation from hemlock looper and decline from Armillaria root rot have been present since 1981. In 1985, a survey of the island revealed healthy full crowns and

no new mortality was observed. Mortality of hemlock continued on the Menominee Tribal Forest in northeastern Wisconsin, Menominee County. A study on the role of Armillaria sp. in hemlock mortality is being conducted on the Tribal Forest by forest pahtologist Johann Bruhn at the school of forestry, Michigan Technological University, Houghton, MI. Plans are for continuing this project in 1986. A mapping crew from the U.S. Forest Service will fly over the forest in 1986 and hemlock mortality will be observed.

LARCH

Larch Needlecast - Mycosphaerella laricina (Hartig) Neg.

Mycosphaerella needlecast of European larch was first reported in Wisconsin and North America in 1980. This disease has been reported in seven counties in western Wisconsin (Figure 7). Defoliation from this disease occurred in late September in west-central Wisconsin, La Crosse County, and appeared to be lighter than 1984 defoliation. The three Wisconsin state nurseries were surveyed for the presence of larch needlecast and no needlecast was found in the state nurseries. In 1984, researchers from the U.S. Forest Service, North Central Forest Experiment Station, initiated a study to determine the host range of this disease by planting various species of larch from different seed sources. In 1985, the study was expanded to include the planting of trees from 10 additional seed sources, which totals 20 seed sources in the study. The trees were planted adjacent to an infested plantation on the Coulee Experimental Forest in La Crosse County. Preliminary results indicate that all seed sources were diseased, but to varying degrees. Japanese larch showed signs of resistance with low to moderate foliage infection, as opposed to the Japanese larch hybrid which exhibited moderate to severe foliage infection. Chemical control trials with Benomyl and Chlorothalonil were also initiated. Final results of this three year study will be recorded in 1986.

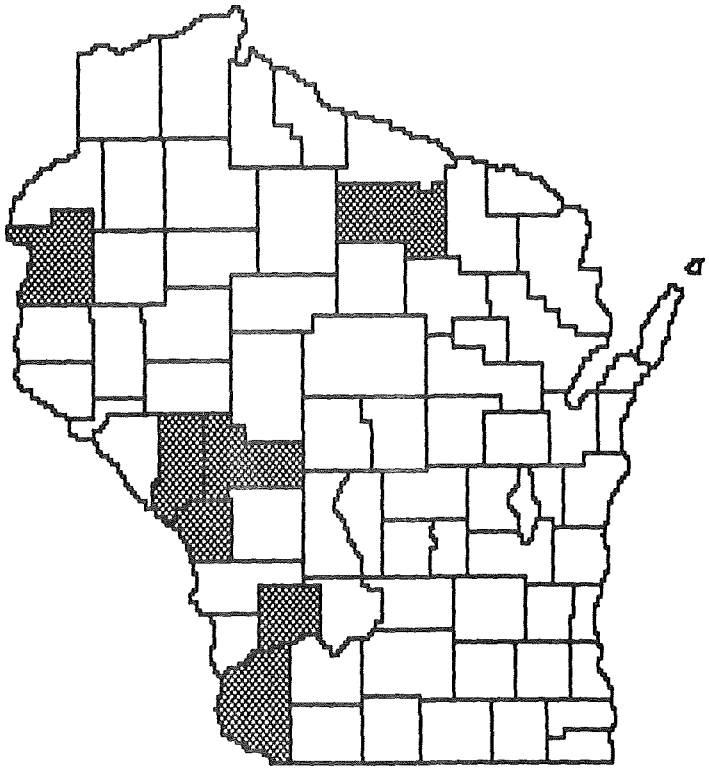

Figure 7. Known county locations of Larch Needlecast in Wisconsin - 1985.

MAPLE

Greenstriped Mapleworm - Dryocampa rubicunda (Fab.)

A 1000 acre infestation in Douglas County collapsed in 1985.

Bruce Spanworm - Operophtera bruceata (Hulst)

An outbreak erupted over a large area in several northeastern counties (Figure 8). Light to heavy defoliation of sugar maple occurred in most of the northern hardwood stands in this area. Pockets of heavy defoliation occurred in Menominee and Forest counties. The outbreak was apparently initiated in 1984 when about 200 acres of maple were defoliated in Menominee County. This is the first recorded outbreak of this insect in Wisconsin.

Adult populations were very high in late 1985 in Menominee County. Increasing area and intensity of defoliation are expected in 1986.

Phenological note: October 31 - Adult emergence ending.

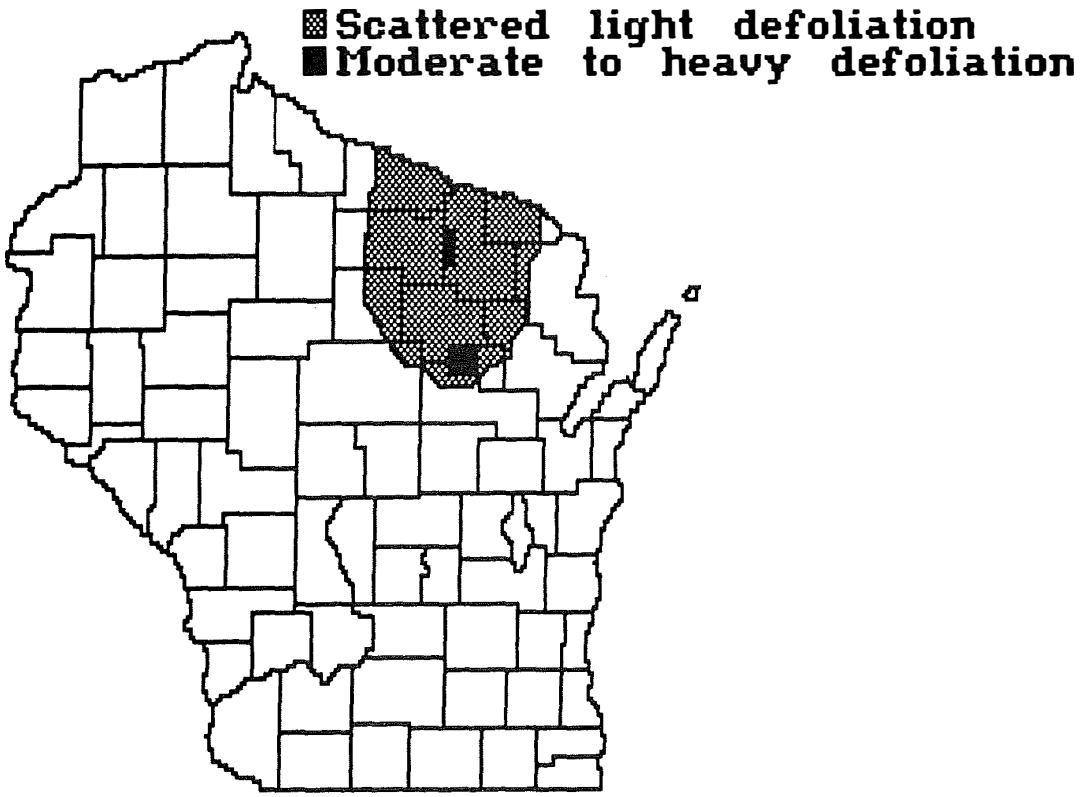

Figure 8. Area of defoliation caused by Bruce Spanworm - 1985.

Sapstreak - Ceratocystis coerulescens.

Sapstreak disease of sugar maple, previously observed in Forest County, was detected on the Menominee Indian Reservation in 1984. The area affected on the reservation had been logged within a year of development of symptoms. Dwarfed leaves and crown dieback were observed on sugar maple in western Menominee county. Root wounds from the logging equipment were present on affected trees. No surveys were conducted.

OAK

Actinopelte Leaf Spot - Actinopelte dryina (Sacc.) (Hoehn)

This disease caused leaf spotting and browning on red, black, white and northern pin oaks in central and northwestern (Polk and Burnett counties) Wisconsin.

Oak Wilt - Cerctocystis fagacearum (Bretz) Hunt

Two new county locations were observed in northeastern Wisconsin in 1985, they were Marinette and Brown counties. An aerial survey of Marinette County revelaed three oak wilt pockets along the Wisconsin - Michigan border and the pathogen was positively identified from a yard tree located in Section 5, T33N, R21E, just north of State Hwy 180. Symptoms of oak wilt were observed at two additional locations in Marinette County in the Town of Wausaukee. A positive sample from an oak in the City of Green Bay makes Brown County the fifty first county with oak wilt (Figure 9). An increase in the number of epicenters in Shawano County was observed around Shawano Lake and the Clover Leaf Lakes. In southwest Shawano County, a logging operation on private land in June, lead to the development of four epicenters in a 40 acre stand of high quality red oak. Attempts to eradicate oak wilt in the Legend Lake area of Menominee County were intense in 1985.

A schedule for monitoring and controlling oak wilt in the Legend Lake Area follows:

July
- *Aerial survey to detect the presence of wilting trees.
- *Reexamine old infestations to detect any infections that have "jumped" the trenches.
- *Collect samples from wilting trees to confirm infection.
- *Label infected trees with a notice that informs landowners of what action they should take such as tree removal between October 1 and March 31 and proper disposal of the wood.

August and September
- *Notify town forester of locations of infected trees.
- *Town forester notifies landowners.

September and October
- *Mark trench locations.
- *Put in trenches to break root grafts.

October - March
- *Remove infected trees (all within the first trench line).

March - April
- *Complete burial, chipping and burning.

By following this schedule, the spread of oak wilt along Legend Lake, was minimized.

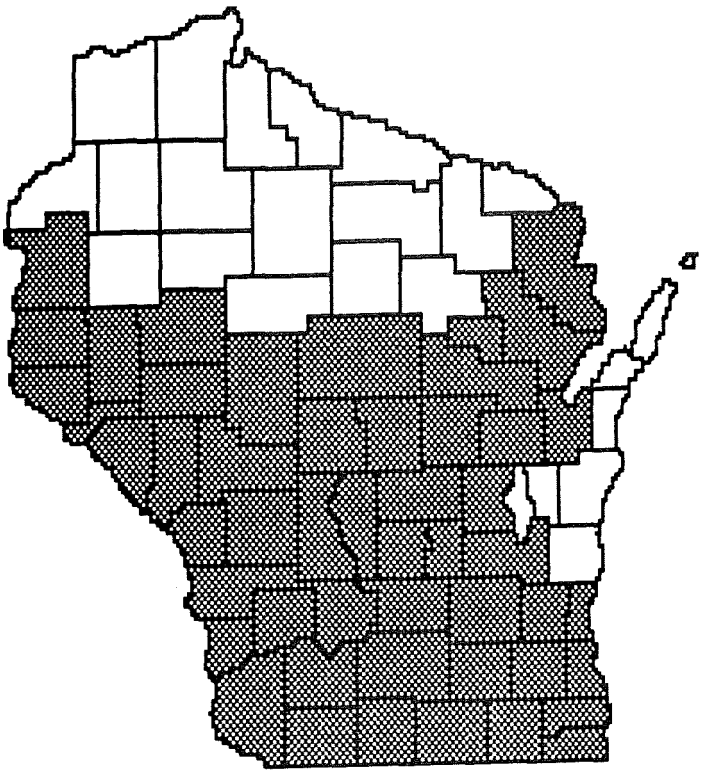

Figure 9. Known county distribution of Oak Wilt in Wisconsin - 1985.

Oak Webworm - Archips fervidanus (Clemens)

The incidence of this minor pest declined in Douglas and Bayfield counties.

Oak Skeletonizer - Bucculatrix ainsliella Murtfeldt

Scattered small pockets of light to moderate early season defoliation occurred in Monroe, Sauk and Green counties.

Fall Cankerworm - Alsophila pometaria (Harris)

A new outbreak erupted in the south-central counties (Figure 10). Pockets of light to severe deofliation of oaks and associated hardwoods occurred.

Associated defoliators:
Elm Spanworm - Ennomos subsignarius (Hubner)
Linden Looper - Erannis tiliaria (Harris) were defoliating oaks, elms and maples in the same area.

The last outbreak of this complex began in this area in 1975. It also was preceded by a period of warm dry spring weather.

Figure 10. Area of light to severe defoliation by Fall Cankerworm - 1985.

Walkingstick - Diapheromera femorata (Say)

Medium to heavy defoliation of oak occurred in 4 sections of Jackson and Clark counties.

(T24N, R4W, S36; T24N, R34, S31; T23N, R4W, S1; T23N, R34, S6). This pocket has been the victim of repeated walkingstick defoliation for several years.

Post Oak Locust - Dendrotettix quercus Packard

A new outbreak began this year which caused pockets of moderate to heavy defoliation on 18,000 acres of black oak in Jackson and Monroe counties (Figure 11).

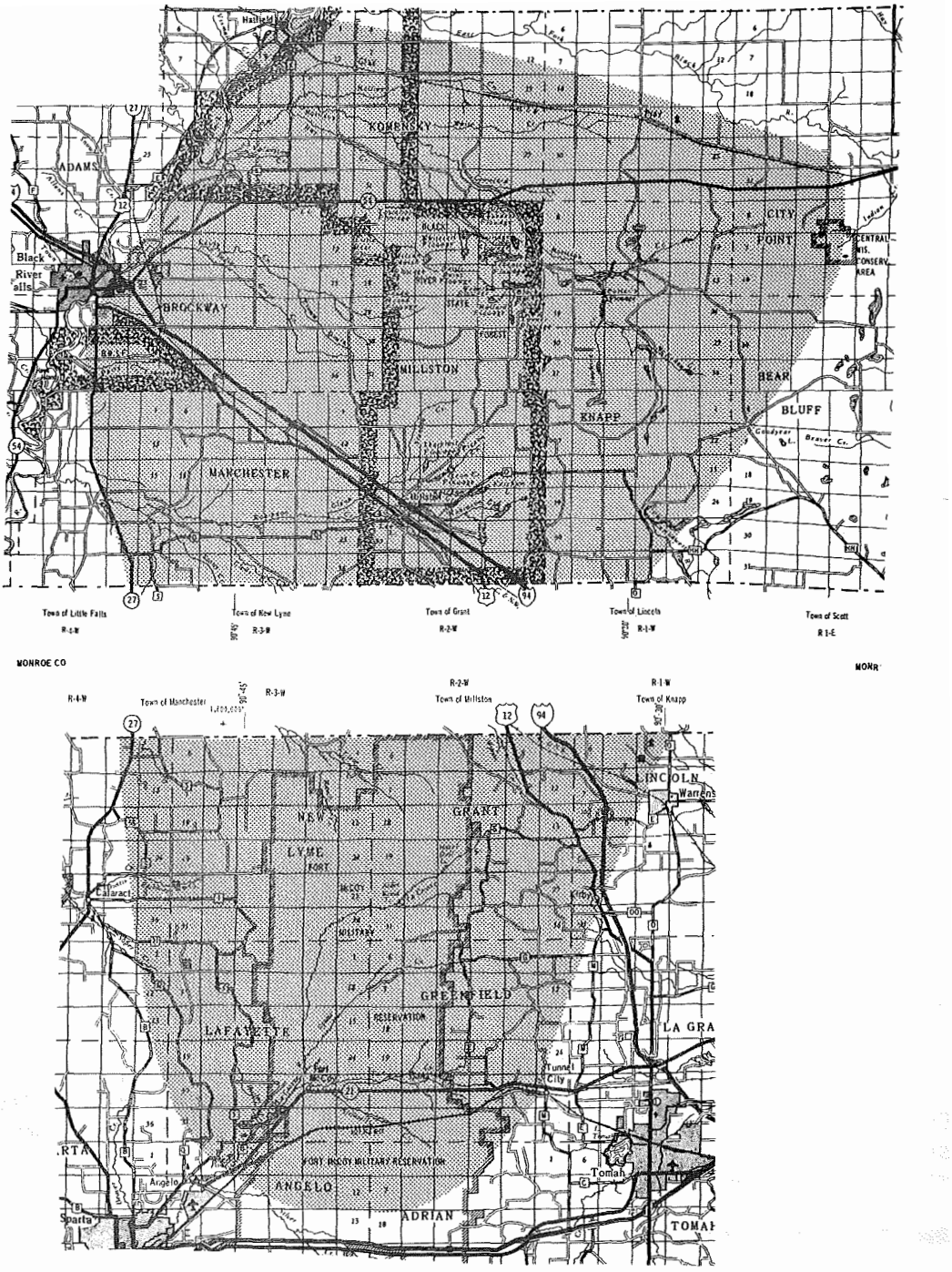

Figure 11. Area of defoliation in Jackson and Monroe counties - 1985.

Orangestriped Oakworm - Anisota senatoria (J.E. Smith)

Individual sapling black oaks were heavily defoliated in Waushara County.

A Leaf Gall Maker - Dryophanta sp.

Repeated yearly attacks by this Cynipid gall maker is causing serious damage to pockets of mature woodlot and shade tree white oak in Dane County. The repeated suppression of foliage development is causing twig dieback and severe general decline of at least one pocket of shade trees.

Attack evidently takes place in late April and early May when the buds are breaking. The bud usually is deformed into a cluster of green galls that resemble a cluster of large buds. Some leaves develop but they are usually deformed. Heavily attacked white oaks produce a second flush of foliage that is heavily attacked by a second gall maker (probably Neuroterus sp.). Heavily attacked leaves have a "bronze" color and often drop early. The size of both types of galls is variable from year to year probably due to timing.

PINE

Diplodia Canker and Shoot Blight - Sphaeropsis sapinea (Fr.) Dyke and Sutton

In 1984 and 1985, Diplodia canker and shoot blight were scattered throughout red and jack pine plantations and natural stands in Douglas County in northwestern Wisconsin. A survey was conducted of two red pine plantations (SE¼, Sec. 13, T45N, R11W; SE¼ Sec 1, T44N, R11W) approximately 8 and 10 years old, respectively, to determine the incidence of shoot blight, canker, and mortality. One thousand trees from each plantation were examined. In both plantations, branch cankers were detected on 4.0% of the trees and shoot blight on 1.5%. A total of 8% of the trees had some form of Diplodia infection and by April, 1985, 1.0% of the trees had died from Diplodia. A survey in August, 1985 revealed no increase in canker incidence.

A moderate incidence of infected 1-0 red pine was observed at the Griffith Nursery, Wisconsin Rapids. At Wilson nursery, Boscobel, heavily infected red pine windbreak trees were removed. Efforts to remove infected windbreaks, the primary source of inoculum, are also ongoing at Griffith Nursery.

Scleroderris Canker - Gremmeniella abietina (Lagerb.)

A survey was conducted in Bayfield County for identification of red pine with infection by Scleroderris. One new location was identified in Bayfield County, Hughes township, in Sec 26, T46N, R9W. The infection was light and scattered throughout two plantations, eight and fifteen years old. The lake states strain was isolated (Figure 12).

Red Pine Shoot Blight - Sirococcus strobilinus (Pruess)

Red pine shoot blight has been previously reported in seven counties in northern Wisconsin (Figure 13). Known infected areas in Vilas County were surveyed and scattered light infection of 1985 shoots was observed. No new locations of red pine shoot blight were found.

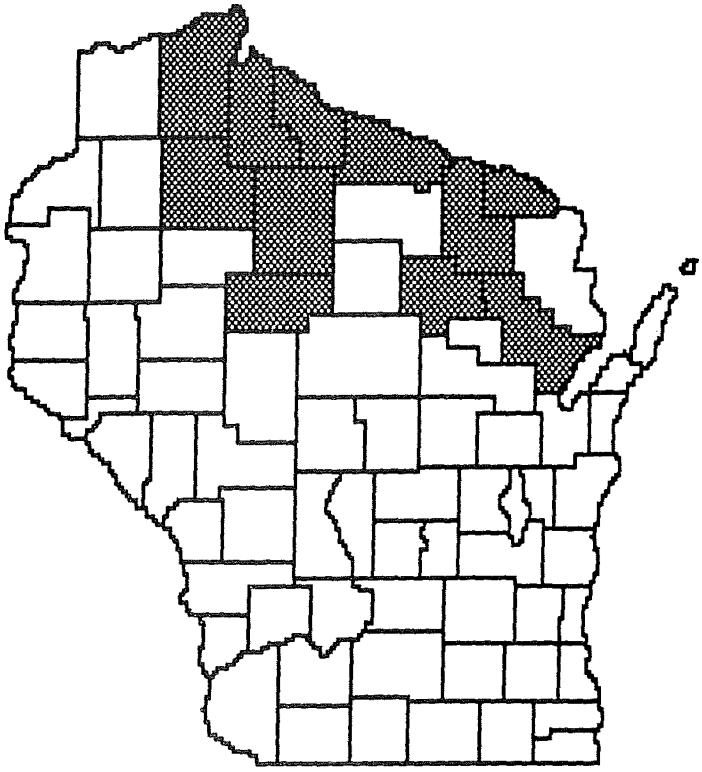

Figure 12. Known county locations of Scleroderris canker - 1985.

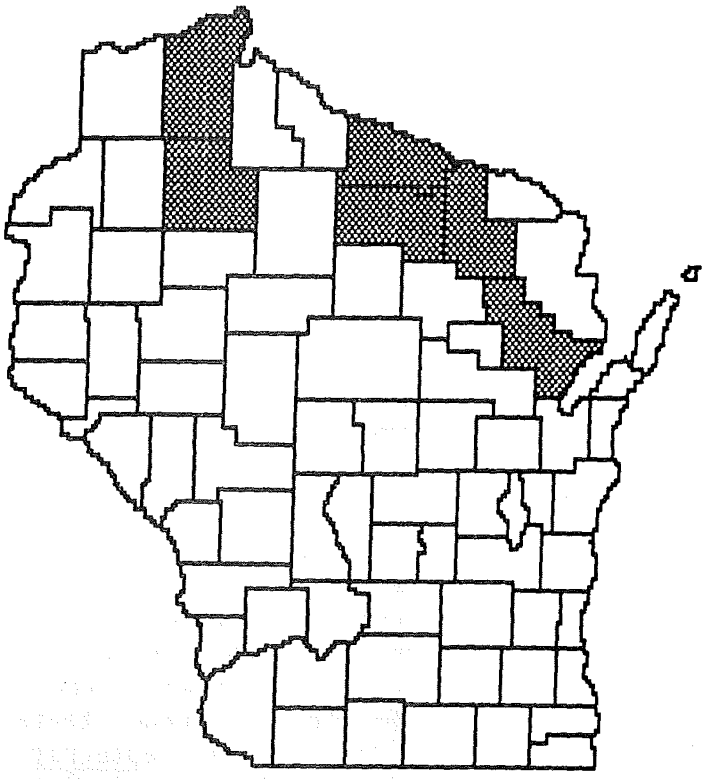

Figure 13. Known county locations of Red Pine Shoot Blight - 1985.

Red Pine Decline and Pocket Mortality

Pockets of declining and dying red pine in plantations and windbreaks have been observed throughout central and southern Wisconsin. This problem most commonly occurs in 35-40-year-old plantations. Symptoms of affected trees are: reduced leader and branch-tip growth, loss of older needles, and fading of needle color. A single tree or small group of trees die, followed by mortality of adjacent trees. These circular pockets of dead trees have expanded up to 0.3 acre per year. In 1984, four locations were examined and results were reported in the 1984 Forest Conditions in Wisconsin Annual Report. In summary, several pests were commonly present; red pine shoot moth, Armillaria root rot, Diplodia shoot blight, root collar weevil, root tip weevil, bark beetles, and pine wood nematode. Different combinations of these pests have been observed and no one of these pests can be attributed to being the cause. In 1985, six additional pockets were observed in southern, and central Wisconsin (Table 1 and Figure 14). In Sauk County, two pockets were excavated and root systems of healthy, dying, and dead trees were exposed. A fungus, Leptographium sp. was isolated from the root system of a tree on the edge of one of the pockets. Because of the association of the genus Leptographium with root diseases of pine, more excavation and isolation work is planned for 1986. Efforts will also continue to determine the association of this fungus with the dying trees, and the significance of insects, in particular the root weevils, in the decline process.

TABLE 1. Locations of red pine decline and mortality investigated in 1985.

County	Legal Description	Disease Description
Jefferson	T5N, R16E, Sec. 36 NE¼, along Viele Rd.	On the Kettle Moraine State Forest, scattered dead and dying 20-year-old trees in a one acre area. Younger plantations adjacent to this area are healthy. No evidence of recent thinning. Pests observed - Diplodia shoot blight, turpentine beetles, bark beetles. Black locust trees were scattered among the dying red pine.
Sauk[1]	T8N, R4E, Sec. 19	Two 0.3 acre pockets in a 17 acre plantation, approximately 40 years old, on the River Valley School Forest. First observed in 1972, thinned in 1975. Pests observed - Diplodia shoot blight, root collar weevil, pine wood nematode, bark beetles. A fungus tentatively identified as Leptographium terebrantis, was isolated from the roots of a tree on the edge of the

County	Legal Description	Disease Description
		pocket. In 1981 and 1982, one pocket was sanitized and dead and dying trees were removed. The pocket continued to expand in 1983, 1984 and 1985. In 1985, several new pockets of three or less dying red pine were observed in the school forest.
Sauk	T8N, R3E, Sec. 8	A 0.1 acre pocket of dead and dying red pine in a 30 year old plantation along a wayside on Hwy 14. Thinned within the last five years. Heavy night shade in the understory.
Walworth	T4N, R15E, Sec. 35, SE¼	Approximately 75 trees dead in a 20-year-old plantation. Also scattered small pockets (2 trees) within the plantation. Pests observed - bark beetles. Heavy night shade in the pocket and scattered in the plantation. The soil is heavy with a gravel component.
Walworth	T4N, R16E, Sec. 3	Dead and dying trees scattered throughout a two acre plantation. Adjacent to a 300 acre, 20-year-old plantation that had been thinned within the last five years. Pests observed - Diplodia shoot blight, root collar weevil, root tip weevil, turpentine beetle, bark beetles. Black locust trees were present in some areas of the two acre plantation.
Waupaca	T21N, R12E, Sec. 8	Approximately 10 trees dead and dying in a seven acre, 37-year-old plantation. Was thinned in 1974. Pests observed - bark beetles.
Waupaca	T21N, R13E, Sec. 31	Approximately 20 trees dead in a 50 acre, 25-year-old plantation. Has been thinned once. Pests observed - Armillaria root rot and bark beetles.

[1]This pocket was also examined in 1984; all others are new reports for 1985.

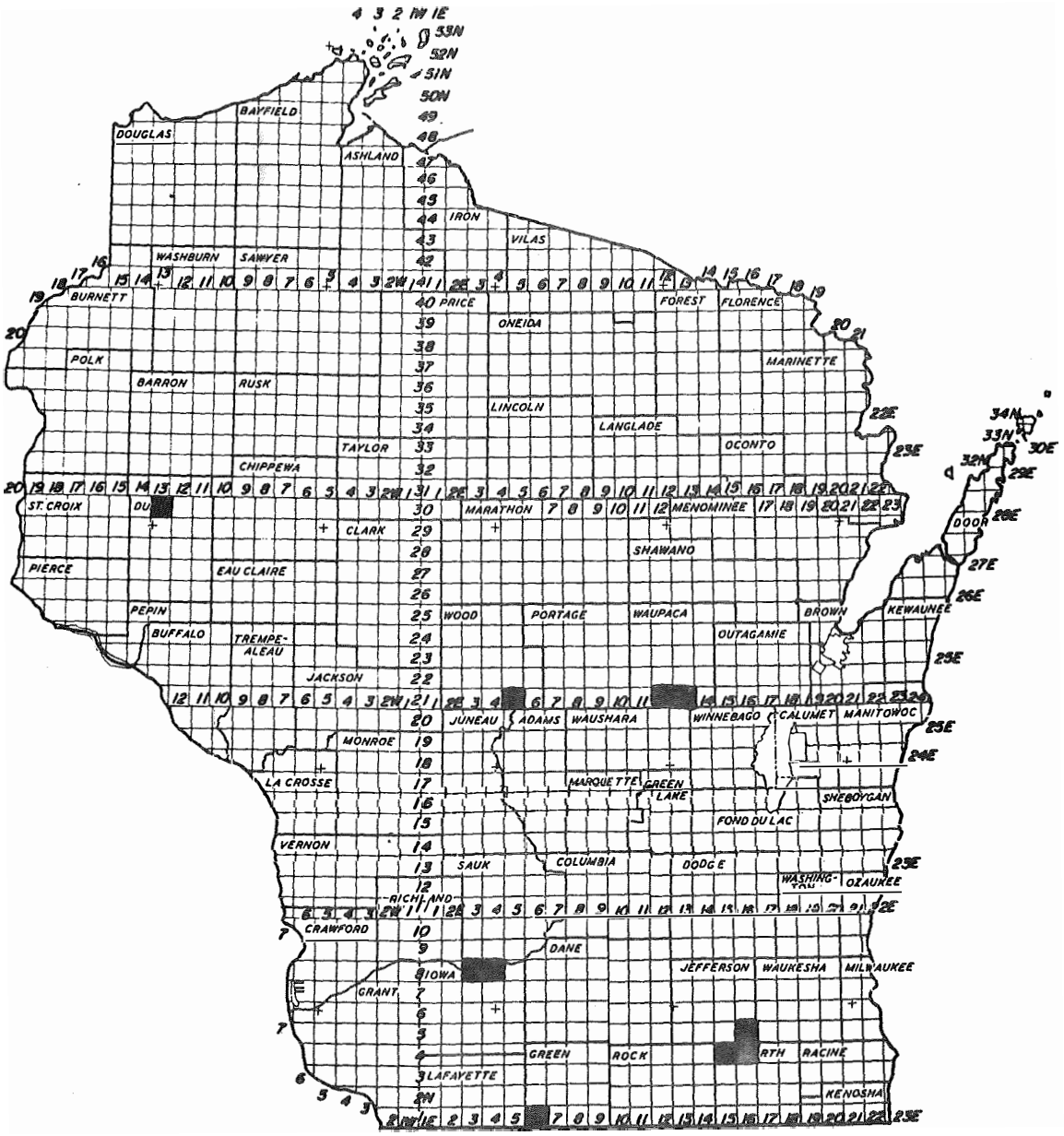

Figure 14. Township location of Red Pine Pocket Mortality that have been investigation - 1985.

Jack Pine Budworm - Choristoneura pinus (Rohwer)

The continuing outbreak in northwestern Wisconsin (Figure 15) increased in severity in Polk and Burnett counties and declined in Douglas and Bayfield counties. About 30,000 acres in Polk and Burnett counties suffered heavy to severe defoliation. Populations declined in the rest of the outbreak area which had only light or no defoliation. Egg mass counts indicate a sharply reduction in populations in 1986 in Douglas, Bayfield and Washburn counties but only slight reduction in Polk and Burnett counties.

The infestation in Jackson County increased in area so that 7500 acres were moderately defoliated.

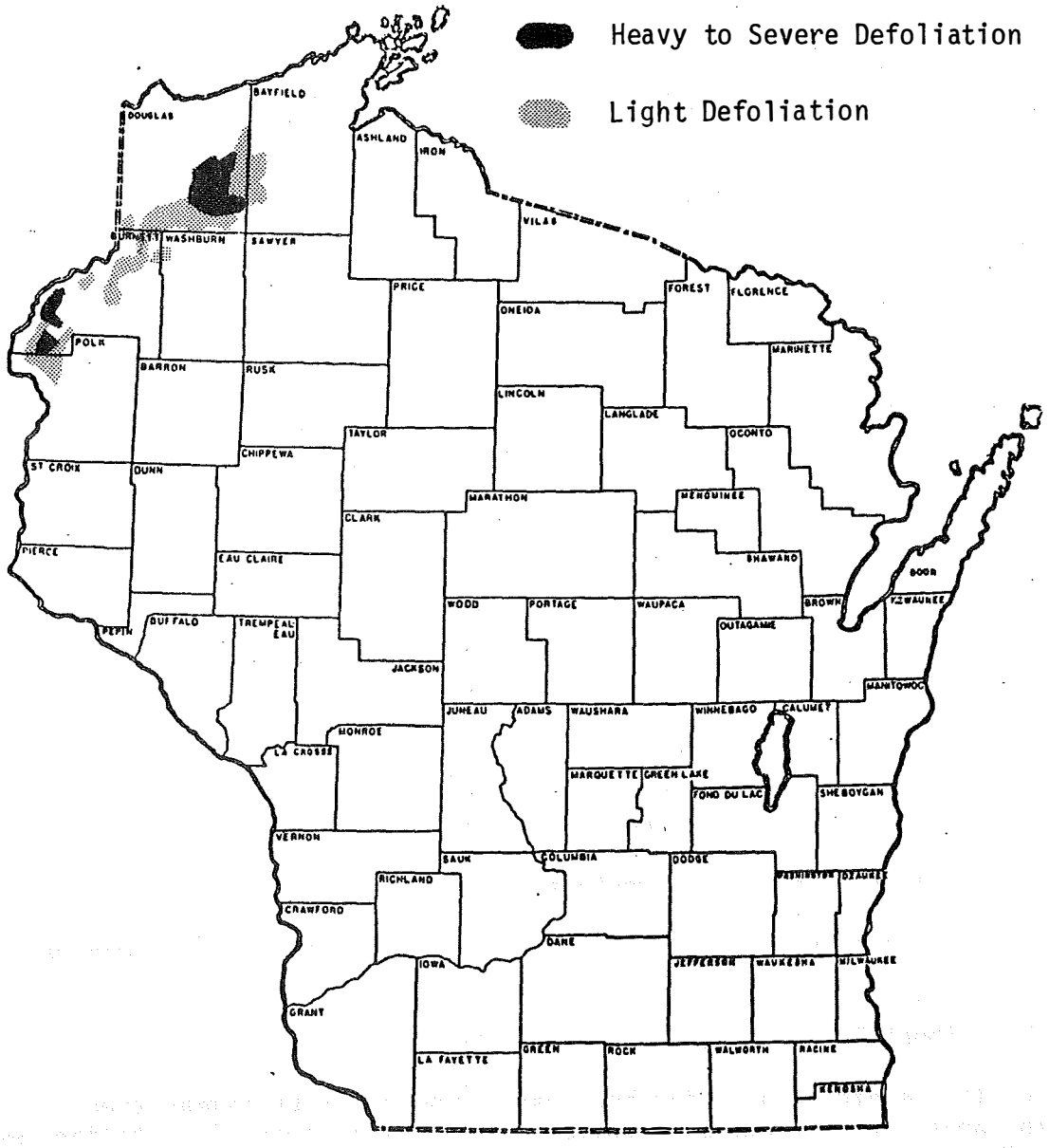

Figure 15. Area of heavy to severe and light defoliation by Jack Pine Budworm - 1985.

Pine Tussock Moth - Dasychira pinicola (Dyar)

Populations continued at extremely low levels in the previously infested areas in Douglas and Bayfield counties. No defoliation was reported.

European Pine Sawfly - Neodiprion sertifer (Geoffroy)

Populations were reduced from 1984 levels. Colony numbers and defoliation were very low in Walworth and Waukesha counties. The number of reports of this defoliator remained about the same in Jefferson, Dane and Green counties.

A Pine Sawfly - Neodiprion maurus Rohwer.

A rare infestation of this pine defoliator was found near Hixton in Jackson County.

Redheaded Pine Sawfly - Neodiprion lecontei (Fitch)

Populations generally increased in northern Wisconsin. New infestations were found and known infestations increased in severity in Forest, Oneida, and Sawyer counties. An infestation in Price County subsided. Several pockets of 1984 defoliation of red pine were discovered in Forest County.

About 90 acres of sapling sized red pine were sprayed with mist blower applications of malathion in Forest County. Pockets of severe defoliation occurred over about 300 acres of red pine plantations in Sawyer where about 160 acres were spot sprayed with malathion 57% EC at 0.8 pt in 2 gallons per acre. Pheromone-baited traps were tested as a means of monitoring sawfly populations. The numbers of male sawflies caught in traps, generally reflected the subsequent numbers of colonies found in red pine plantations. See Appendix A.

Phenological Notes:

May 28 - Adults began laying eggs in Forest County.
July 3 - Larvae in 3rd and 4th instars in Columbia County.
July 10 - 25% of eggs hatched in northeastern Wisconsin.

Introduced Pine Sawfly - Diprion similis (Hartig)

No significant change occurred in the light populations. The normal numbers of reports of colonies and light defoliation were received.

Red Pine Shoot Moth - Dioryctria resinosella Mutuura

Populations continued at very low levels in the hazard zone in the central counties.

Eastern Pine Shoot Borer - Eucosma gloriola Heinrich

Attacks of this scotch pine deforming insect erupted in Christmas tree production areas in the central counties. Moderate to heavy infestations were reported in scotch pine in Washburn County.

Pine Grosbeak - Pinicola enucleator

Locally heavy bud feeding occurred on balsam fir Christmas trees in central Langlade County during the 84-85 winter. Most of the damage occurred near the tops of trees; all size classes were affected.

Saratoga Spittlebug - Aphrophora saratogensis (Fitch)

Populations were substantially reduced in the northeastern counties but increased in Sawyer County in northwestern Wisconsin. Herbicide treatment of alternate host vegetation in previous years was responsible for some of the population reduction. About 145 acres of red pine plantations were sprayed with an aerial application of malathion in water at the rate of 10-fl. oz/A. on state forest land in Iron, Vilas and Oneida counties.

Pine Spittlebug - Aphrophora parallela (Say)

Populations of nymphs were high on jack and white pine in the northwestern counties but caused no visable damage.

Pine Bark Adelgid Pineus strobi (Hartig)

Light infestations were present on white pine in Washburn and Sawyer counties.

Pine Root Collar Weevil - Hylobius radicis (Buchanan)

Scotch pine mortality increased markedly in commercial Christmas tree plantations in the central sands. An unusual number of trees 1-2 inches in diameter at the ground level were fading in the spring.

Poorly stocked red pine plantations on light sandy soil are being heavily attacked in Washburn (T40N, R13W) and Burnett (T40N, R15W) counties where some plantations have suffered 25% mortality.

A study was initiated in Portage County to test Diazinon, Dursban and Furadan as alternatives to Lindane for weevil control. Results will be published in future annual reports.

Pales Weevil - Hylobius pales (Herbst)

An unusually large amount of twig feeding on white and Scotch pine occurred in the south-central counties in the spring. Some of the damage was associated with red pine thinning; most occurred near harvested Christmas trees.

White Pine Weevil - Pissodes strobi (Peck)

Weevil attacks declined in some southcentral infestations in white pine and jack pine. A heavy infestation was reported in Eau Claire County.

Phenological Note:

June 12 - larvae beginning to pupate.

Northern Pine Weevil - Pissodes approximatus (Hopkins)

This weevil killed large numbers of conifers in new plantations in the east-central counties. The hot dry spring weather and resulting moisture stress was the most likely predisposing agent. Occasionally poor planting practices were associated with the damage. Heavy damage was found in white pine in Menominee and Marinette counties and in white spruce in Marinette County and in red pine in Lincoln County.

Pine Bark Beetles - Ips sp.

The warm dry spring weather proved beneficial to pine bark beetles. Pockets of dead red pine appeared in unusually large numbers on sandy soils in the central and southern counties.

Where piled pulpwood was left in the woods too long, a few nearby jack and red pines were killed. Some of these attacked trees still had green foliage in November.

On the Northern Highland State Forest, 1200 cords of jack pine pulpwood were treated with Chlorpyrifos (at 2½ oz of 22.4% Al in one gallon water) to prevent Ips pini attack in the residual stand. About 36 gallons of the mixture were required. Adult beetles emerged in large numbers from the treated material. Trap logs leaning against the piles were also heavily attacked. The surrounding residual stand was not attacked.

Red Turpentine Beetle - Dendroctonus valens LeConte

Attacks by this large bark beetle have become noticeably more numerous this year in the southern counties. Pole and small sawtimber sized red pines in plantations and windbreaks are under increasing attack. Occasionally attacks are found on dead red pines but more often they are found on green, otherwise healthy trees. See Red Pine Decline and Pocket Mortality for more information.

A Bark Beetle - Pityogenes hopkinsi Swaine

A rare attack of healthy white pine occurred in Marquette County (T14N, R10E, S11). A late spring thinning of pole-sized white pine provided brood material for spring adults. Second generation adult beetles emerged in mid summer and attacked the residual stand. The trunks of attacked trees were dotted with small droplets of white pitch. None of the attacks examined were successful; in every case, the attacking beetle drowned in the pitch. The residual stand suffered no apparent damage.

White Grubs - Phyllophaga sp.

Scattered reports of white grub damage to young conifers planted in 1984 and 1985 were received from several central and east-central counties. Adult June beetle numbers were extremely high in Columbia and Waushara counties.

Plains Pocket Gopher - Geomys bursarius

Five to ten-year-old red pines on poor sand in eastern Douglas County suffered substantial damage from this root destroying rodent. A 40 acre plantation that had 10% mortality in 1984, had an additional 10% mortality in 1985. In another plantation, 5% of the trees died in 1985.

White Pine Needlecast - Scirrhia acicola (Dearn.) Siggers

This needlecast was first reported on white pine in Wisconsin in 1984. Four locations were confirmed, one from each of the following counties; Buffalo, Burnett, Jackson and Douglas. In 1985, needlecast and needle spots were light at all known locations. Observations of this disease will continue in 1986.

White Pine Needle Blight - Atmospheric gases.

In a cooperative project between the DNR Bureau of Air Management and Bureau of Forestry, a 30 county area in eastern Wisconsin was surveyed to determine the extent and frequency of tip burn and mottling on eastern white pine. Tip burn and mottling are symptoms of exposure to ozone and sulfur dioxide. Five plantations per county were sampled. Plantation ages ranged from 5 to 15 years. In northeastern Wisconsin, plantations in the desired age group could not be found, so natural stands were used. One hundred trees per plantation (in a 10x10 tree block) and one branch from each tree were sampled.

Presence or absence of tip burn and severity of mottling were identified on second year needles. Tip burn is defined as the area at the tip of the needle displaying a red-brown discoloration. Yellow tips and yellow bands were not classified as tip burn. Mottled needles were defined as those needles with randomly scattered grey and white flecks. Yellow or brown spots were not classified as mottling. Severity of mottling was recorded as 0%, 5%, 25% or 50% of the needle surface area covered by spots. The stem rust of cereals severity assessment key was used to determine the severity. A total of 10,706 trees in 109 plantations were surveyed.

The percentage of white pines exhibiting tip burn or mottling were calculated for each county (Figures 16 and 17). Values for each county were based on the total number of trees sampled within the county. White pines with tip burn (25.3%) were most frequent in southeastern Wisconsin; compared to 11.4% in the east-central area and 1.1% in the northeastern area. These percentages suggest a gradient of decreasing tip burn incidence from southeast to northeast Wisconsin.

Values for significant mottling severity (greater than 25% of the needle surface area affected) were also calculated (Figure 17). In southeastern Wisconsin, 8.6% of the trees sampled exhibited significant mottling, 13.0% in east-central and 0.6% in northeastern Wisconsin.

Tip burn and mottling were observed more frequently in the southeastern and east-central areas of Wisconsin than the northeastern area of the state. The number of trees exhibiting symptoms decreases from the south to the north.

In general, those trees which exhibited tip burn also had mottling. Because of higher concentrations of gaseous air pollutants and the higher frequencies of symptoms to white pine needles in southeastern Wisconsin, tip burn and mottling may be associated with the higher SO_2 and O_3 levels. A detailed report of this study entitled, "Regional Effects of Sulfur Dioxide and Ozone on Eastern White Pine in Eastern Wisconsin," is available from the Bureau of Air Management or Bureau Forestry, Department of Natural Resources, Madison, WI.

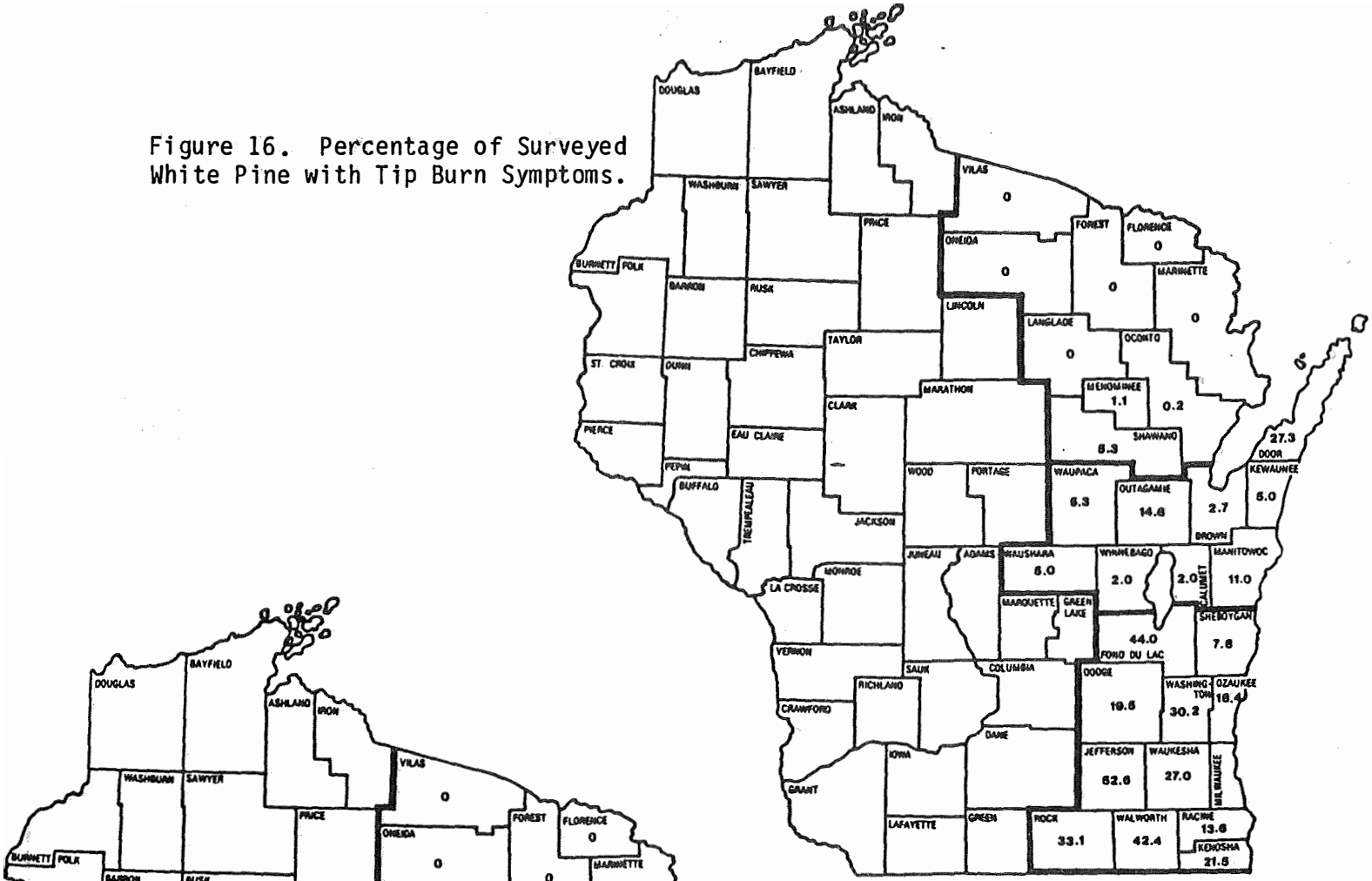

Figure 16. Percentage of Surveyed White Pine with Tip Burn Symptoms.

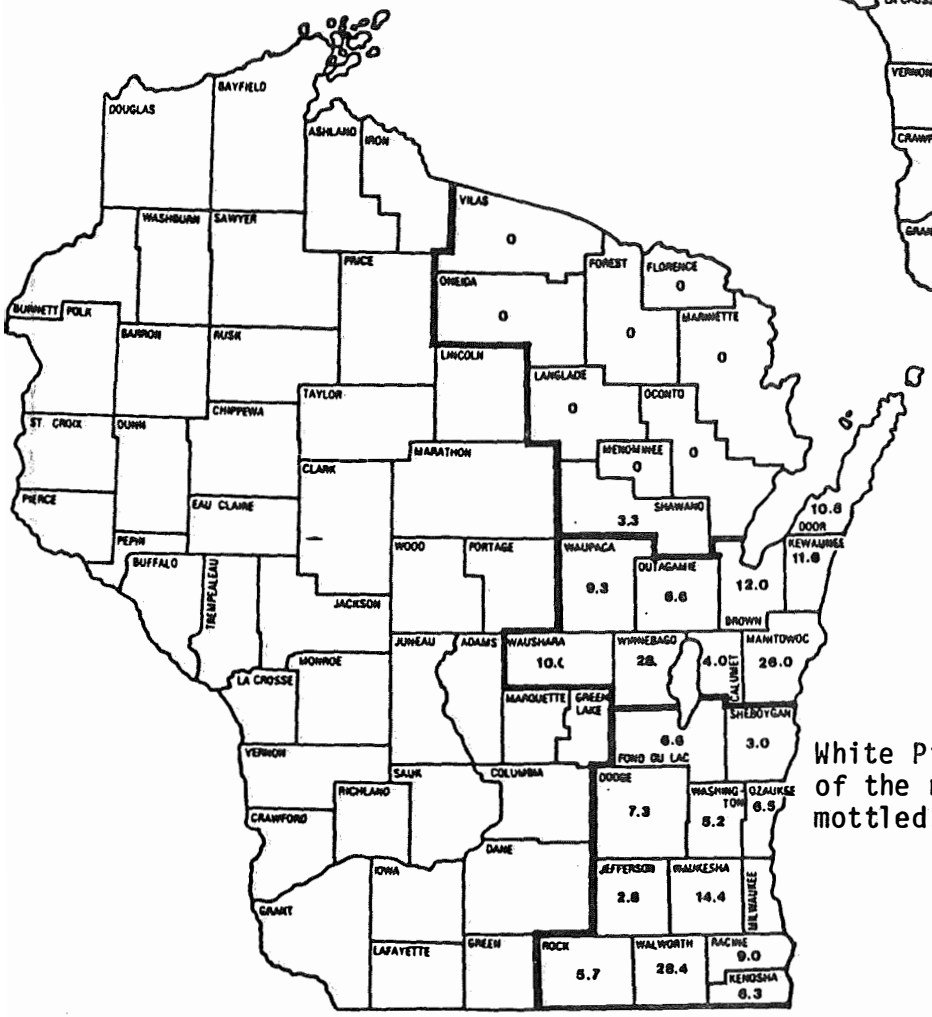

Figure 17. Percentage of Surveyed White Pine with greater than 25% of the needles' surface area mottled.

BLACK WALNUT

Plantation Black Walnut Canker - Fusarium sporotrichioides Sherb.

In 1984, a cooperative study between the Department of Natural Resources and the University of Wisconsin (Dr. James Kuntz - forest pathologist) was initiated to determine the cause of a canker on black walnut and its relationship to two types of pruning wounds.

The pruning wound study was done on a plantation in southwestern Wisconsin, Vernon County with cooperation from landowner James Olson, Forester John Bliss, and Technician Al Groth.

A fungus, Fusarium sporotrichiodes was found to be the cause of the canker. Four factors were analyzed for their effect on canker incidence.

1. Date of pruning
2. Type of pruning cut (flush with the stem, or a cut leaving a one inch stub)
3. Location of potential inoculum or older cankers, and
4. Presence or absence of potential inoculum or older cankers

The only factor found to have a significant effect on canker incidence was date of pruning. The number of cankers formed on trees pruned in May was significantly higher than the number of cankers formed on trees pruned in August (Figure 1, Appendix B). This study did not analyze canker development on trees pruned during the dormant season but observations of plantations where dormant season pruning has been followed, show a low incidence of canker.

This study examined the potential of existing cankers to produce spores for inoculation of non-cankered trees within ten feet. If the spores travel farther than ten feet but stay in and around the infected plantation, sanitation (cutting and removing cankered trees) could eliminate the inoculum. If the spores are ubiquitous, removal of infected trees would probably not reduce canker formation. A sanitation experiment will begin in 1986 in the Vernon County plantation. Results of the study were presented at the American Phytopathological Society meeting in Reno, Nevada and a detailed report is given in Appendix B.

With cooperation from DNR foresters, surveys were done in Vernon, Crawford, Lafayette and Grant counties to determine canker incidence (Table 1).

TABLE 1. Incidence of walnut canker in various locations in southwestern Wisconsin.

Property Owners	Location	Canker Incidence[1]
Forrest Turner	Crawford County T10N, R3W, Sec. 17	26%/100
Birger Anderson	Crawford County T10N, R5W, Sec. 2	31%/100
Gerald Boehm	Crawford County T9N, RW, Sec. 5	0/100
Pete Domeyer	Grant County T6N, R5W, Sec. 24	33%/50
State of Wisconsin Douglas Hallock Memorial Demonstration Forest	Grant County T6N, R5W, Sec. 10, 4	22%/89
James Olson	Vernon County T11N, R5W, Sec. 18	32%/100
Lloyd Kirk	Lafayette County T1N, R4E, Sec. 18	3%/60
Chester Lee	Vernon County T12N, R5W, Sec. 6	0%/30

[1]Percent of trees with cankers/number of trees surveyed.

Cankers were observed around pruning wounds, dead branches and occasionally not associated with any wound or branch. Cankers were present in purned and unpruned stands and in pure walnut plantations and plantations interplanted with pine. Canker incidence was highest in plantations along stream beds and valley bottoms.

MISCELLANEOUS SPECIES

Gypsy Moth - Lymantria dispar (L.)

Eradication attempts appear to have been successful in three infestations; trap catch was reduced to zero this year. The Oconomowoc infestation was discovered in 1977 and had been treated with aerial and ground applications of Disparlure, virus, Bacillus thuringiensis, carbaryl and mass trapping. The Monona infestation was discovered in 1981 and was treated only with mass trapping and burlap banding. The Hubertus infestation was discovered in 1983 and was treated with two applications of Bacillus thuringiensis this year. In previous years, infestations in Appleton, Elm Grove and Delavan have been eradicated.

The number of male gypsy moths caught declined drastically in 1985. A total of 13 males were trapped in 10 locations; in 1984, 79 were trapped in 23 locations. Table 2 lists the locations and numbers of male moths trapped and was taken from a summary provided by the Wisconsin Department of Agriculture Trade and Consumer Protection.

TABLE 2. Male Gypsy Moths trapped in Wisconsin in 1985.

County	Community	No. of Moths
Clark	York Twp	1
Dane	Madison	1
Marinette	Peshtigo	1
Milwaukee	Bayside	3
	Milwaukee	1
Ozaukee	Belgium Twp	1
Shawano	Bonduel	2 (second year)
Washington	Jackson Twp	1
Waukesha	Chenequa	1
Wood	Port Edwards	1
	State Total	13

Fall Webworm - Hyphantria cunea (Drury)

The numbers of webs declined dramatically in 1985. The heaviest numbers were on butternut and ornamental birches along the Mississippi River from La Crosse to Prairie du Chien. Webs were locally common in Marquette and Waukesha counties.

A Bagworm - Fumaria costa (Fall)

A small infestation of this insect was found near Hixton in Jackson County. this was the first infestation of this insect found in Wisconsin. The larvae eat the old bark of the twigs and new shoots of balsam fir, pine, white cedar and red cedar. They occasionally build thier bags on the siding of houses causing a minor nuisance.

Phenological note:

26 June - Adult males flying.

Air Pollution

A survey for air pollution injury to vegetation was conducted along Romar Avenue in Milton, Wisconsin, Rock County. An inventory of the insects and diseases present on vegetation was taken. The survey revealed symptoms of ammonia injury (necrotic spotting primarily along leaf margins and bright tan interveinal lesions) on a honeysuckle and an oak tree, and on box elder trees south of the Tomah and Terra Companies.

Another survey was conducted in the vicinity of Chrome-Tech of Wisconsin, Inc., West Milwaukee. Samples were collected for suspected damage from sufuric acid and/or chromium. Symptomatic samples were collected and filed at the pest lab. Samples were also sent to the State Lab of Hygiene for analysis of chromium content.

A survey for possible air pollution injury to vegetation was conducted in the downtown Park Falls area. The injury to foliage observed resembled that caused by sulfur dioxide. Injury was observed near the Flambeau Paper Mill. Acute injury was observed on white birch mugo pine, flowering crab, white cedar, yew, juniper, and dandelion. No insects or diseases caused the symptoms.

CHRISTMAS TREES

Cyclaneusam Needlecast - Cyclaneusma minus (Butin) DiCosmo, Peredo and Minter

Cyclaneusma needlecast causes early yellowing, needle loss and degrades Christmas trees.

Cyclaneusma needlecast disease of Scotch pine, commonly present in low levels in Wisconsin, increased in severity in 1984. Scotch pine Christmas tree plantations in Waushara County, central Wisconsin, were surveyed for disease incidence in 1985. Twenty-two plantations ranging in age from 4-to 9-years-old were surveyed. In each plantation, 0.2% of the trees were checked for visual symptoms (apothecia). Anywhere from 66 to 970 trees per plantation were surveyed, depending on the total number of trees present (Table 3). Cyclaneusma was detected in all twenty-two plantations surveyed and on 95% of the trees surveyed.

Four branch samples, one from each of the cardinal directions, were collected from the 50th tree surveyed in each plantation for isolations. Needles from 1983 and 1984 compliments were isolated from. Results are listed in Table 4. No significant differences were observed between isolations from the different directions on the trees, but Cyclaneusma was consistently isolated more frequently from the 1983 compliment of needles than from the 1984 compliment. This may be due to a higher infection of the 1983 needles that have had two years of exposure to inoculum, opposed to one year of exposure of 1984 needles.

The high frequency of Cyclaneusma prompted a state-wide mail survey cooperative project between the Wisconsin Department of Natural Resources and the US Forest Service, State and Private Forestry. In October, 1985, sample packets were sent to members of the Wisconsin Christmas Tree Producers Association with a request for samples from Scotch pine and information on location and age of the trees. Samples that returned were checked for the presence of apothecia. If none were obtained, isolations were made from the two-year-old needles. Results are listed in Table 5. Figure 18 shows the counties where Cyclaneusma has been reported; either from the 1985 mail survey or from previous reports. A follow-up letter giving results and survey and control information was mailed to all growers who responded.

TABLE 3. Number of acres surveyed, and number and percent of trees with Cyclaneusma needlecast; Waushara County.

Plantation	Acres	Trees with Cyclaneusma	
		No.	(%)
1	33	55	83
2	122	194	79
3	93*	502	54
4	29*	290	100
5	84	168	100
6	41*	334	82
7	46	92	100
8	100	195	97
9	91	182	100
10	134	264	99
11	78	155	99
12	100	200	100
13	123	246	100
14	69	138	100
15	48	96	100
16	70	140	100
17	56	112	100
18	60	120	100
19	120	239	99
20	59*	590	100
21	40*	400	100
22	97*	965	99
TOTALS	1693	5677	95

*1.0 percent of the trees were surveyed in these plantations. All others had 0.2 percent of the trees surveyed.

TABLE 4. Percent of needles from which Cyclaneusma minus was isolated in relation to location of branch sample and age of needles.

	Location of branch sample; side of tree from which sample was taken									
	North		EAST		SOUTH		WEST		ALL DIRECTIONS	
PLANTATION	1983[1]	1984[2]	1983	1984	1983	1984	1983	1984	1983	1984
1[3]	NNP[4]	0.0	66.7	0.0	100.0	0.0	33.3	0.0	66.7	0.0
2	0.0	20.0	0.0	10.0	10.0	40.0	0.0	0.0	2.5	17.5
3	0.0	0.0	10.0	10.0	0.0	0.0	0.0	0.0	2.5	2.5
4	90.0	30.0	90.0	50.0	60.0	70.0	80.0	80.0	80.0	57.5
5	0.0	10.0	0.0	10.0	0.0	20.0	NNP			
6	70.0	40.0	0.0	0.0	70.0	50.0	20.0	10.0	40.0	25.0
7	10.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	12.5	0.0
8	30.0	20.0	20.0	0.0	NNP	10.0	30.0	0.0	26.7	7.5
9	0.0	20.0	0.0	40.0	90.0	40.0	40.0	90.0	32.5	47.5
10	50.0	0.0	30.0	70.0	40.0	50.0	10.0	30.0	32.5	37.5
11	0.0	10.0	0.0	0.0	40.0	0.0	10.0	10.0	12.5	5.0
12	0.0	0.0	0.0	0.0	10.0	20.0	0.0	10.0	2.5	7.5
	80.0	40.0	80.0	20.0	100.0	20.0	INA[5]	INA	86.7	26.7
13	10.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0
14	100.0	70.0	60.0	80.0	50.0	10.0	20.0	0.0	37.5	12.5
15	30.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0
16	40.0	20.0	30.0	40.0	70.0	50.0	60.0	50.0	50.0	40.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	5.0
18[3]	50.0	0.0	83.3	50.0	33.3	0.0	66.7	16.7	58.3	16.7
19	10.0	10.0	60.0	0.0	40.0	0.0	0.0	0.0	27.5	2.5
20[3]	100.0	66.7	33.3	0.0	83.3	0.0	0.0	0.0	54.2	16.7
21	80.0	30.0	80.0	70.0	80.0	10.0	60.0	0.0	75.0	27.5
22	50.0	10.0	20.0	0.0	0.0	10.0	60.0	20.0	32.5	10.0
ALL PLANTATIONS	34.9	17.9	28.9	20.6	43.8	21.6	25.2	19.6	33.2	19.6
EACH DIRECTION	26.3		24.8		32.4		26.3			

[1] Needles two years old.
[2] Needles one year old.
[3] Isolations were attempted from 6 needles/sample; isolations were attempted from 10 needes/sample for all other plantations.
[4] NNP = needles not present on sample.
[5] INA = isolation not attempted.

TABLE 5. Results of the 1985 state-wide mail survey of Scotch pine Christmas trees for Cyclaneusma minus.

Sample packets sent out	317
Growers who responded	40
Growers with Cyclaneusma - infested plantations	26
Growers with negative samples, no Cyclaneusma	3
Growers with no Scotch pine or who responded but sent no sample	11

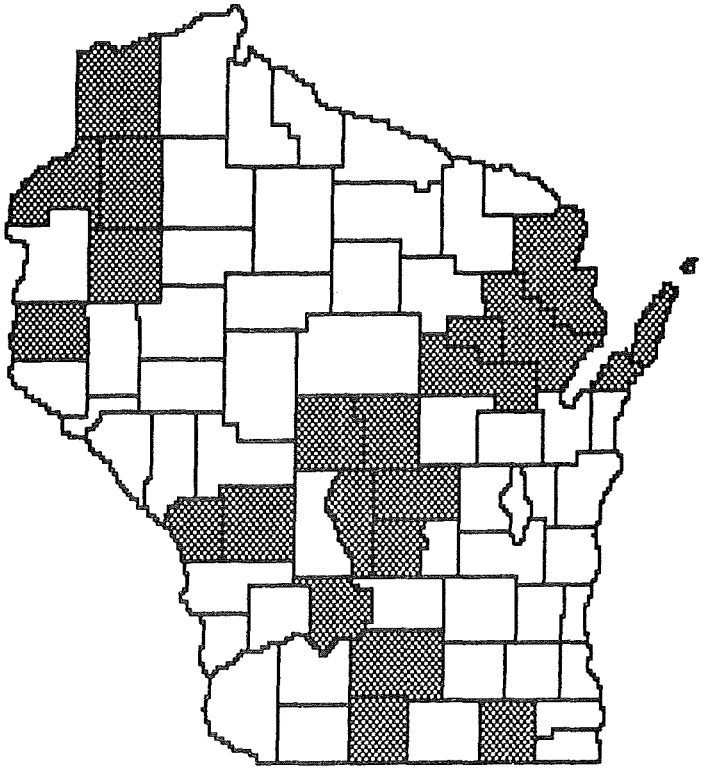

Figure 18. Known county locations of Cyclaneusma needlecast of Scotch pine - 1985.

NURSERY

White Pine Root Rot - Cylindrocladium sp. and other unknown causes.

White pine mortality caused by Cylindrocladium and other unknown causes continued to occur at Griffith and Wilson nurseries (Wisconsin Rapids and Boscobel, Wisconsin, respectively). Mortality of white pine has been occurring since 1976 and incidence has been fluctuating with an increase at Wilson Nursery in 1984 and 1985. A survey of the 3-0 white pine at Wilson Nursery was conducted in October to determine the incidence of root rot. Thirty-four plots were distributed randomly throughout 15 rows of two sections. One hundred trees were lifted from each plot. Each of the 3,400 trees were carefully checked for rotted roots and classified as vigorous and healthy or severely root rotted (less than 25% of residual roots healthy). Foresters Craig Hollingsworth and Ray Amiel assisted with the sorting. Results are listed in Table 6.

The percent of trees with rotted roots varies from 8 to 75, and there was no observable pattern in the beds. There were pockets of heavily infected trees scattered throughout the beds. The percent of trees with root rot that had top symptoms such as chlorosis or browning was also calculated and no correlation was found between the appearance of the tops and the condition of the roots.

A greenhouse and field experiment are planned for 1986 to determine the relationship between root rot severity and seedling survival in the greenhouse and field. Also, the sorting crew at Wilson Nursery will be trained during lifting and sorting in April, 1986, to recognize healthy and rotted rot systems, so the stock shipped will have adequate roots.

TABLE 6. Percent of 3-0 white pine with severe root rot, Wilson Nursery, Boscobel, WI

Location C-50		Percent with Root Rot	Location C-49		Percent with Root Rot
Row	Plot		Row	Plot	
5	1	48	9	1	65
5	2	29	9	2	10
5	3	30	9	3	21
5	4	21	9	4	30
5	5	40	7	1	31
4	1	55	7	2	37
4	2	25	7	3	28
4	3	33	7	4	39
4	4	41	5	1	75
4	5	20	5	2	29
2	1	8	5	3	33
2	2	24	5	4	50
2	3	59	3	1	59
2	4	11	3	2	50
			3	3	45
			3	4	57
			1	1	74
			1	2	44
			1	3	52
			1	4	39

Appendix A

Redheaded Pine Sawfly Phermone Study

Beth Schuh and David Hall[1]

Introduction

At high population levels, redheaded pine sawfly (Neodiprion lecontei) larvae can completely strip a coniferous tree of its needles. Their preference for commercially important red pine (Pinus resinosa) in northern Wisconsin has led to the use of insecticides for their suppression. In 1985, 44 and 497 acres were broadcast sprayed and spot sprayed, respectively, for redheaded pine sawfly control.

To better manage our forests for control of redheaded pine sawfly, we are investigating the use of phermone traps to monitor sawfly populations. The major redheaded pine sawfly phermone component was identified and synthesized by Jewet et. al. (1976) as an acetate ester of 3,7-dimethylpentadecan-2-01 (diprinol). Further work by Kraemer et. al. (1981, 1983) on redheaded pine sawfly selectiveness toward a specific optical isomer and chirality of the isomer has provided us with a species specific synthetic phermone for use in this study.

Methods and Materials

This study was conducted in 12 red pine stands in the Argonne Unit of Consolidated Papers, Inc. in Oneida and Forest Counties. With the knowledge of previous sawfly activity, 20 red pine stands were visually surveyed for the intensity of 1984 sawfly activity. This survey was conducted by randomly walking through each stand and noting the number of trees with sawfly defoliation and the percent of defoliation on each of these trees. Each stand was placed into a defoliation class of light, moderate or severe dependent upon the amount of defoliation observed.

Definition of each class were as follows:
light = 10 trees with single branch defoliation;
moderate = pockets of trees with branch defoliation
severe = defoliation common throughout stand plus pockets of completely defoliated trees.

Three stands in each condition class and 3 stands with no previous sawfly activity (condition class = clean) were selected for our phermone study. To further justify the placement of each stand in their respective condition class a more intensive survey of the previous years defoliation was conducted. In this survey, all trees in a stand were examined. Those with sawfly defoliation were recorded by the amount of defoliation as follows: single colony; less than 25% of the tree defoliated, 25-50% and 50-100%. Rob Meyer of Consolidated Paper, Inc. provided us with an estimate of the number of trees/acre allowing us to calculate the approximate percentage of trees with defoliation in a plantation.

Three stands from each condition class were selected in order to test 3 different phermone concentrations, 5, 10 or 15 micrograms of sex phermone per bait. Phercon II traps (Zoecon Corp., Palto Alto, CA) were set up following the technique of Kraemer et al, 1981. Phermone samples were dissolved in 1.0 ml aliquots of distilled n-hexane and sealed in glass ampules at University of Wisconsin, Department of Entomology under the direction of H. Coppel. Each ampule was broken in the field and its contents poured onto a 4.0 cm cotton dental wick. The wick was suspended from the trap roof by a hair clip. The traps were attached to pine branches 1-1.5 meters above the ground on the southwest edge of each stand. The traps were changed once a week, but the initial bait was used throughout the trapping season.

A phermone baited trap was also placed at the Consolidated Papers, Inc. office near Argonne. The trap was baited with a 30 microgram concentration of phermone. The trap, not the bait was changed once every 3 days. This trap was used to monitor the adult male flight period. All trapping ended following three weeks of zero male catch in the office trap (Figure 1).

Results and Discussion

Our initial random survey of previous year's defoliation was used to select 12 pine plantations for our 1985 phermone study. The need to classify the defoliation into clean, light, moderate, and severe was important in determining if plantations were reflecting different population levels and thus may affect the number of males caught in the phermone traps. Since this was a critical factor in evaluating trapping results, the second more intensive survey was conducted. Adjusted results of both surveys are presented in Table 1. The actual number of trees per acre and acreage varied considerably between plantations, therefore, results were adjusted to x/300 trees/acre for comparison purposes.

The phermone trapping results presented in Table 2 demonstrates that all concentrations will attract male sawflies. This phermone is difficult to obtain and the ability to use low concentrations with effective results is a critical factor when considering the use of this phermone trapping as a management tool. Further studies should investigate lower concentrations.

At 5 mg/ml phermone, trap results show a trend toward increasing number of male sawflies caught with an increase in the amount of previous years defoliation. To determine if these results were reflecting 1985 population levels, a count of larval colonies was conducted in each plantation. Adjusted larval colony counts are presented in Table 2. Although male sawflies were trapped in all 3 clean plantations, no larval colonies were observed. We must conclude that these sawflies imigrated into the plantation during the flight period, or less likely, emerged from cocoons which had been in the plantation duff at least 2 years. The number of males trapped in light and moderate plantations does not accurately represent the level of infestation. However, the number of males caught in the severe plantation does correspond to a high larval population. Further work is needed to be able to relate sawfly catch to larval infestation.

[1]Laboratory technician and forest entomologist, Department of Natural Resources, Madison, WI.

TABLE 1. 1984 Redheaded pine sawfly defoliation of red pine plantations. (Number of trees are adjusted to trees defoliated/300 trees)

COMPARTMENT	CONDITION CLASS	ACREAGE	NO. TREES WITH SINGLE BRANCH DEFOLIATION	% OF TREE DEFOLIATED			TOTAL NO. TREES WITH DEFOLIATION	% TREES DEFOLIATED
				25%	25 - 50%	50 - 100%		
73005	Clean	10	0	0	0	0	0	0
74114	Clean	4	0	0	0	0	0	0
62009-A	Clean	6	0	0	0	0	0	0
52010-C	Light	4	0	1	0	0	1	0.5
52010-B	Light	4	1	1	1	0	3	1
62005-A	Light	9	1	3	0	0	4	1
52008-A	Moderate	3	1	4	1	0	62	
52009-A	Moderate	2	8	15	5	1	29	10
52008-C	Moderate	4	8	14	6	4	32	11
74064-D	Severe	13	10	19	5	6	40	13
62007	Severe	3	7	22	20	42	91	45
52008-D	Severe	3	13	26	16	80	135	30

TABLE 2. Redheaded pine sawfly trapping results at various concentrations of phermone and results of counts of larval colonies.

COMPARTMENT	CONDITION CLASS	ACREAGE	PHERMONE CONCENTRATION (Micrograms)	TOTAL NO. ADULT MALE SAWFLIES TRAPPED/300 TREES	TOTAL NO. LARVAL COLONIES OBSERVED/ 300 TREES
74114	Clean	4	5	7	0
62009-A	Clean	6	10	15	0
73005	Clean	64	15	2	0
52010-B	Light	4	5	29	1
52010-C	Light	4	10	41	3
62005-A	Light	9	15	14	20
52009-A	Moderate	2	5	202	12
52008-A	Moderate	3	10	66	12
52008-C	Moderate	4	15	297	32
52008-D	Severe	3	5	377	255
52007	Severe	3	10	356	188
74064-D	Severe	13	15	92	43

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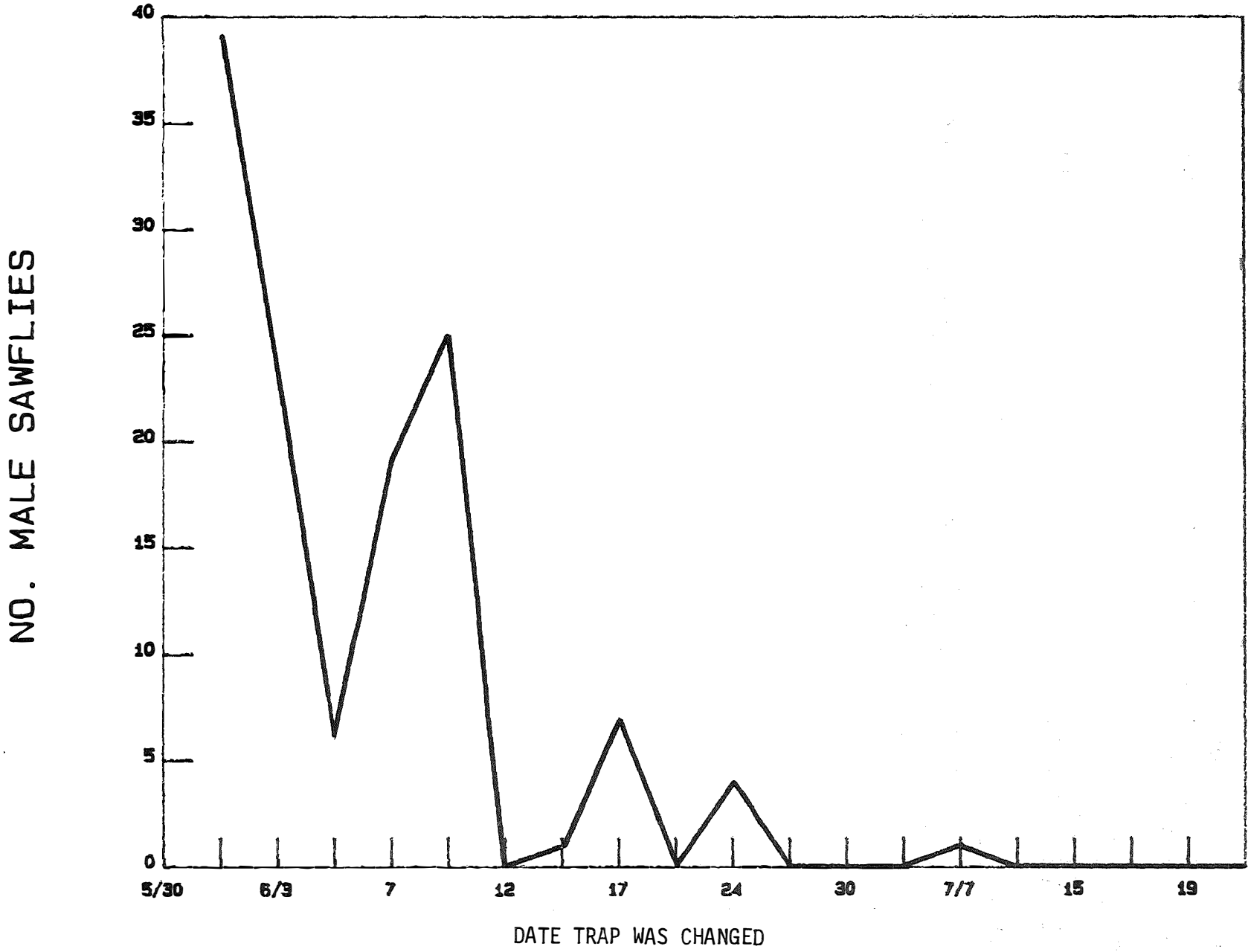

Figure 1. Number of male sawflies in a phermone baited trap at Consolidated Papers, Inc. office, Argonne, Wisconsin - 1985.

Appendix B

Stem Canker on Black Walnut Caused by Fusarium Sporotrichiodes

Jane E. Cummings and James E. Kuntz[1]

Abstract

Fusarium sporotrichiodes Sherb., a pathogen newly recorded on black walnut, causes a narrow elongate trunk canker in southwestern Wisconsin and southeastern Minnesota. Incidence of cankers is highest on saplings in plantations in valleys and along stream beds. Cankers have marginal callus and surround a branch stub or wound. Stem-wound inoculation of greenhouse seedlings cause epinaty of leaves and wilting of leaflets. The optimum temperature for sporulation in greenhouse conditions was 24°C. On wound-inoculated saplings in the field, bark and wood were colonized followed by canker development. In a heavily infected stand, new cankers developed at pruning wounds on trees pruned monthly from May through September. Observations and evidence suggest removal of understory brush and infected trees and pruning during the dormant season are the best silvicultural controls.

Introduction

In Wisconsin, black walnut Juglans nigra, is grown for its high valued wood. A grower's goal is to produce a veneer log free from defect and decay. In 1979, walnut growers in southwestern Wisconsin reported the presence of an elongate trunk canker on plantation grown walnut. The canker has been observed on walnuts in southeastern Minnesota and southwestern Wisconsin. The cankers are perrenial, have marginal callus, and range in length from 3 inches to more than 8 feet. Very long cankers are commonly seen and a single canker may start at the root collar and end in the crown.

A fungus, Fusarium sporotrichioides was isolated from 150 cankered trees in southwestern Wisconsin and southeastern Minnesota. The fungus was identified by Dr. Kuntz and confirmed by Dr. Caldwell at the University of Wisconsin. The unique characteristics of polyphialids bearing oval to pear-shaped microconidia identified this species of Fasarium.

Materials and Methods

Pathogenicity Tests

Pathogenicity tests were done on seedlings in the greenhouse. One-month-old walnut seedlings were wounded by cutting a small slit in the stem with a spear point and inoculated with a mixture of spores and mycelium. After inoculation, wounds were wrapped with cotton then aluminum foil for 48 hours. Disease development was compared between 10 seedlings that were wounded and inoculated seedlings had epinasty of leaves and wilting of

[1]Forest Pathologist Department of Natural Resources, and Professor Emeritus, University of Wisconsin-Madison.

leaflets. A typical progression of symptoms is epinasty, wilting, necrosis and death. This experiment was repeated 10 times. In these replicates, inoculated seedlings that did not wilt and die over winter and in May, 1985, the cankers became active again and mortality continued. As of August 1, 1985, 87 percent of the wound inoculated seedlings had died versus none of the checks.

To determine the optimum temperature for disease development and pathogen sporulation, seedlings were incubated at 16, 20, 24, 28 and 32^{o}C for 10 days prior to inoculation and for several days after inoculation until development of wilt symptoms and pathogen sporulation. Frequency of canker development and pathogen sporulation was significantly higher at 24^{o}C.

Pruning Study

Pruning walnuts reduces the size and extent of knots that will appear in the logs when they are harvested. Current recommendations for pruning walnut branches to create a clear stem and encourage prompt healing of pruning wounds are to begin pruning when stems are 2 to 8 inches in diameter. This will confine pruning to branches that are less than 2 inches in diameter and produce knots only in a small inner core. Branches should be pruned close to the stem, but not so close as to cut into the branch collar. Pruning should be done in late winter or early spring to promote rapid wound healing.

Preliminary observations of natural cankers indicated that cankers surrounded branch stubs or wounds. To determine the effect of two types of pruning wounds on canker incidence, a study was initiated in an infected 15-year old walnut plantation in southwestern Wisconsin. The plantation is located in a valley along a stream bed in an alluvial soil. Eighteen pruning plots were selected. Each plot had five trees, one center tree and one in each of the four cardinal directions from the center tree. The spacing in this plantation is 10 feet by 10 feet. In twelve plots, a cankered tree was used as the center tree to provide inoculation for infection of pruning wounds. Twleve plots had cankered trees in the center surrounded by noncankered trees, and six plots had all non-cankered trees. Every four weeks, from May to September, 1984, trees in two of the plots with cankered trees in the center and one of the plots with no cankered trees were pruned. At each pruning, all five trees in a plot were pruned, two branches per tree. One branch was cut as flush as possible with the stem and one branch was cut so a stub approximately one inch long was left. Pruning tools were sterilized between cuts. Data on canker incidence were collected in 1985 and four factors were analyzed for their effects on canker formation. These factors are:

1. Date of pruning
2. Flush versus stub cut
3. Location of the tree with respect to the cankered tree in the center of the plot, and
4. Presence or absence of a cankered tree in the center of the plot.

The data were analyzed for the effects of each of these factors on canker incidence on the Statistical Analysis System or SAS. The FUN CAT procedure was used which models functions of categorical responses with a log linear categorical model.

Results and Discussion

The first parameter analyzed was the type of pruning cut. Eighty-seven flush pruning cuts were made, and around these cuts, 20 cankers developed. Out of 87 stub pruning cuts, 18 cankers developed. No significant differences were found in the type of pruning cut and canker formation. Fusarium sporotrichioides was isolated from 50 percent of the cankers sampled.

The second parameter analyzed was the location of trees with cankers formed around pruning wounds, with respect to a central cankered tree. In plots with cankered trees in the center, a total of 5 new cankers formed on trees in the center, 5 cankers formed on trees north of the central tree, 7 to the east, 5 to the south and 3 on trees to the west. No significant effects were found of the location of trees with new cankers with respect to the location of the potential inoculum or cankered tree on a 10 foot by 10 foot spacing.

The third parameter analyzed was the presence or absence of a cankered tree in the plot center. In plots with cankered trees in the center, twelve out of 60 or 20 percent of the trees were cankered and in plots without cankered trees in the center, 8 out of 30 or 26 percent of the trees became cankered. The presence of a cankered tree in the plots' centers did not have any significant effect on canker development.

The final factor analyzed was the date of pruning. In Figure 1, the number of cankers formed are on the vertical axis and the date of pruning along the horizontal axis starting at May 8. The number of cankers on trees pruned on May 8 is significantly different from the number of cankers on trees pruned on August 2. These two dates were the only ones determined to be significantly different, but there appears to be a pattern in the number of cankers formed as the pruning data changes; that is the highest number of cankers formed in the spring and fall and the smallest number of cankers formed in mid-summer.

An additional factor is the possible relationship between the site and canker incidence. All of the site observed with high canker incidence in Minnesota and Wisconsin are bottomland sites where trees are planted in valleys and along stream beds. These are good sites for white pine blister rust to develop and blister rust was frequently seen on white pine planted with the walnut. Currently, DNR pest control is surveying sites like these along valleys and stream beds and sites along dry ridge tops to determine the relationship between site and canker incidence.

One surprise encountered in the study was the sudden wilting of foliage on trees in the plots in late August of 1984. Areas of dead cambium were present on these trees and by June 1, 1985, 25 percent of the trees in the plots were dead.

Conclusions form our first year of work are:

1. Fusarium sporotrichioides causes an elongate trunk canker on black walnut

2. Three factors were found not to have significant effects on canker formation:

a. The type of pruning wound i.e., stub or flush

b. The presence of a cankered tree within ten feet

c. The location of a tree with new cankers with respect to the possible inocullum (again within ten feet).

The only factor found to be significant was the date of pruning. The number of cankers formed on trees pruned in May was significantly higher than the number of cankers formed on trees pruned in August. We are continuing work on this disease and our emphasis will be on continuing the pruning study, but this time inoculating the pruning wounds in the field and extending the study to Chinese walnut Juglans alanthifolia and butternut Juglans cinerea to determine the resistance of these species.

Histopathology work is currently being done at the University of Wisconsin - Green Bay. I will continue my survey work to determine the effect of site on canker incidence and develop silvicultural and chemical controls. We will also investigate the cause of the sudden wilting.

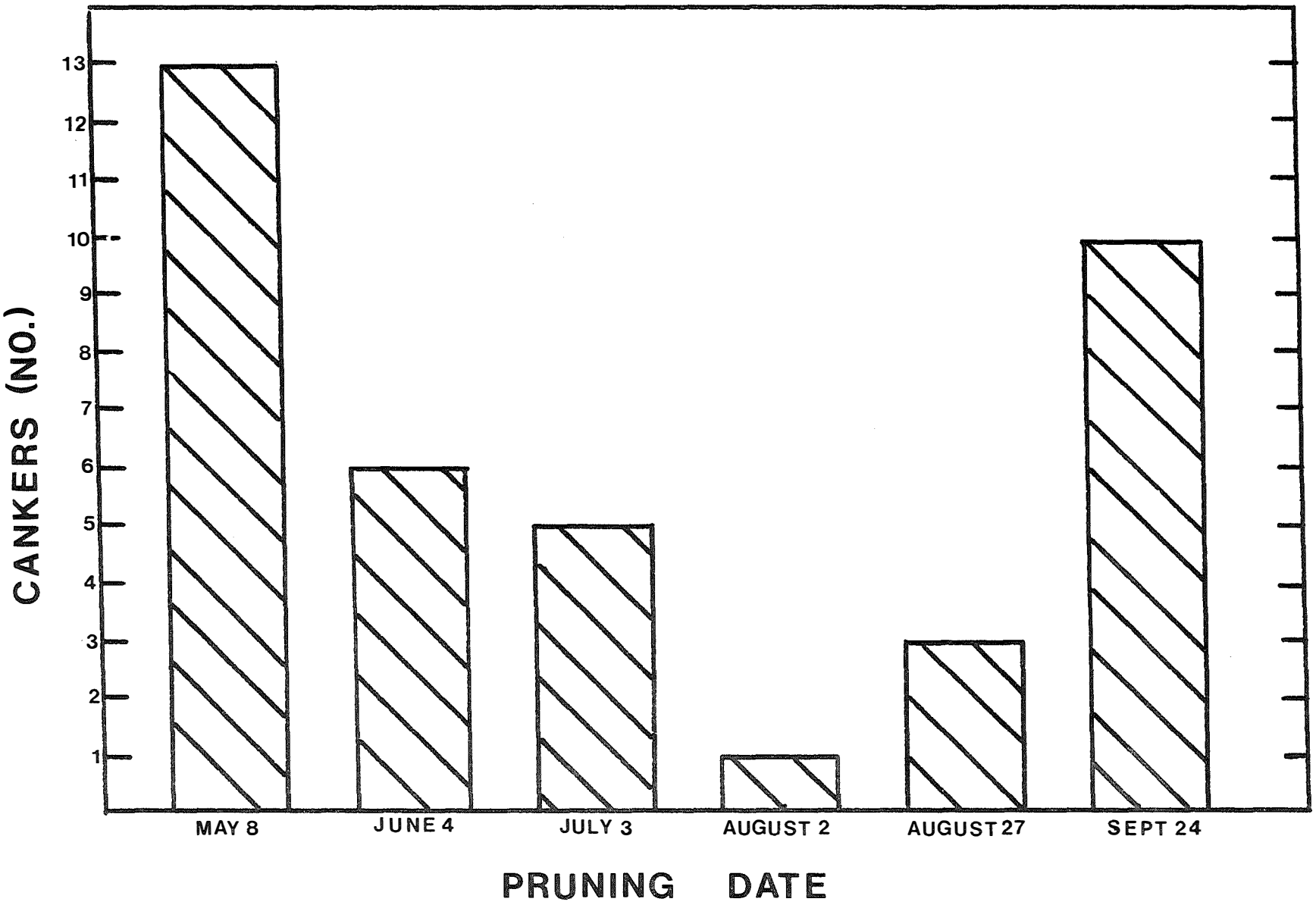

Figure 1. Number of cankers at pruning wounds on black walnuts pruned on various dates.